Factory Management Institute

COOPERATING TO REACH EXCELLENCE

TPM

Total Preventive Maintenance

Volume 1 - V1.8

Factory Management - Muda in Machinery Related in Gemba

Koichi Kimura, Japan-2017

www.factorymanagementinstitute.com

This work consists of 54 pages. Author: Koichi Kimura. Japan-2017. Translation, Adaptation & Edition: Eduardo García. Spain-2017.

Master Koichi Kimura: International Consultant of the TPS (Total Productive System), TQM, TPM (Productive and Total Preventive Maintenance, Kaizen and Factory Management.) Expert in the introduction and fixing of these ones through personal growth and assistance to the management for the change organization. Master Kimura worked in Production Gemba for more than 45 years during which he developed the JIT production system as TIER-1 supplier for Toyota, Honda, etc in the hard and variable field of automotive wiring systems in SUMITOMO Corp even, as General Manager. At this time of publication and over the age of 74, he continues to work on the dissemination of original Japanese methods and continues to work as an international consultant for the last 22 years in more than 11 countries, training clients, as a lecturer and writer. Even experimenting and researching innovative methods and growing in the field of Production Management and Corporate structuration.

Título de la Versión Española:
Factory Mnagement - TPM Mantenimiento Preventivo Total. Volumen 1 – V 1.8
Introducción al TPM, Los 16 Mudas en TPM, Los 7 Mudas en TPS

Title of English Version:
Factory Management - TPM Total Preventive Maintenance. Volume 1 - V 1.8
Introduction to TPM, 16 Muda of TPM, 7 Muda of TPS

Autor/*Author*:
Koichi Kimura – JAPÓN/*JAPAN* © 2017
https://jp.linkedin.com/in/kouichi-kimura-2ba37152/en

Traducción, Edición y Adaptación de la versión Española:
Eduardo L. García – España © 2017
https://es.linkedin.com/in/edulgg

Edition and Adaptation of the English version:
Eduardo L. García – SPAIN © 2017
https://es.linkedin.com/in/edulgg

El Documento ha sido editado para su impresión en Doble Cara sobre DIN-A4
This Document has been edited to double-side printing and DIN-A4

"Factory Management Institute" es una organización en período de constitución a la fecha de la publicación de este trabajo: 6 de Diciembre 2017. www.factorymanagementinstitute.com

"Factory Management Institute" is an Organization in the Period of Incorporation at the date of publication of this work: Dicember, 6th 2017. www.factorymanagementinstitute.com

Nota Legal: *Las marcas registradas mencionadas en este texto son propiedad de sus respectivos dueños. La imagen de los 16 Muda en TPM y el Cronograma pertenecen del JIPM.*

Legal Notice: *Trademarks mentioned in this text are the property of their respective owners. The image of the 16 Muda in TPM and the Evolution of TPM both belong to the JIPM*

INTERNET ARCHIVE

Haga clic en la imagen para ver todas las lecturas del Factory Management Institute de Koichi Kimura, cargada permanentemente y para siempre en Internet-Archive.org
Click on Image to see all Factory Management Institute Lecture by Koichi Kimura, permanently & forever uploaded into Internet-Archive.org

CONTENT

I. INTRODUCTION 5
II. ¿WHAT IS TPM? 7
III. THE 8 PILLARS OF TPM 11
IV. LEARNING TO TPM 15
  1) When introducing TPM… How shall I do? 16
  2) How about the situation of foreign countries? 17
V. PM 'VS' TOTAL PREVENTIVE MAINTENANCE & TPM 21
VI. MUDA 22
  1) The 7 Muda in TPS 25
    Overproduction 26
    Muda by Over-Processing. 36
    Muda by Over-Quality 38
    The SQDF Method: 39
  2) The 16 Muda in TPM 43
    8: Shutdown Loss 44
    12: Automation Replacement 46
  3) The 8 Wastes in "Lean" 48
  4) MUDAs of the Total Preventive Maintenance (TPM) 52
VII. GUIDE FOR THE NEXT LECTURES ABOUT TPM 53

UPDATING TABLE:

Date, Version-Previous ➔ V-Next	Chapter (I..XX...)	Chapter Point.- sub-point : (Updating)
December 2017, V-1.7 ➔ V-1.8	**I.- Introduction**	(Koichi Kimura email introduction to his pupils: Second page of chapter I)
December 2017, V-1.7 ➔ V-1.8	**Updating Table**	This one…
December 2017, V-1.7 ➔ V-1.8	**VI.- MUDA**	Overproduction. Page 33. KPI Blackboards. ("Machine Performance Rate" to "Machine Working Rate" as in TPM-2)

I. Introduction

Dear friends;

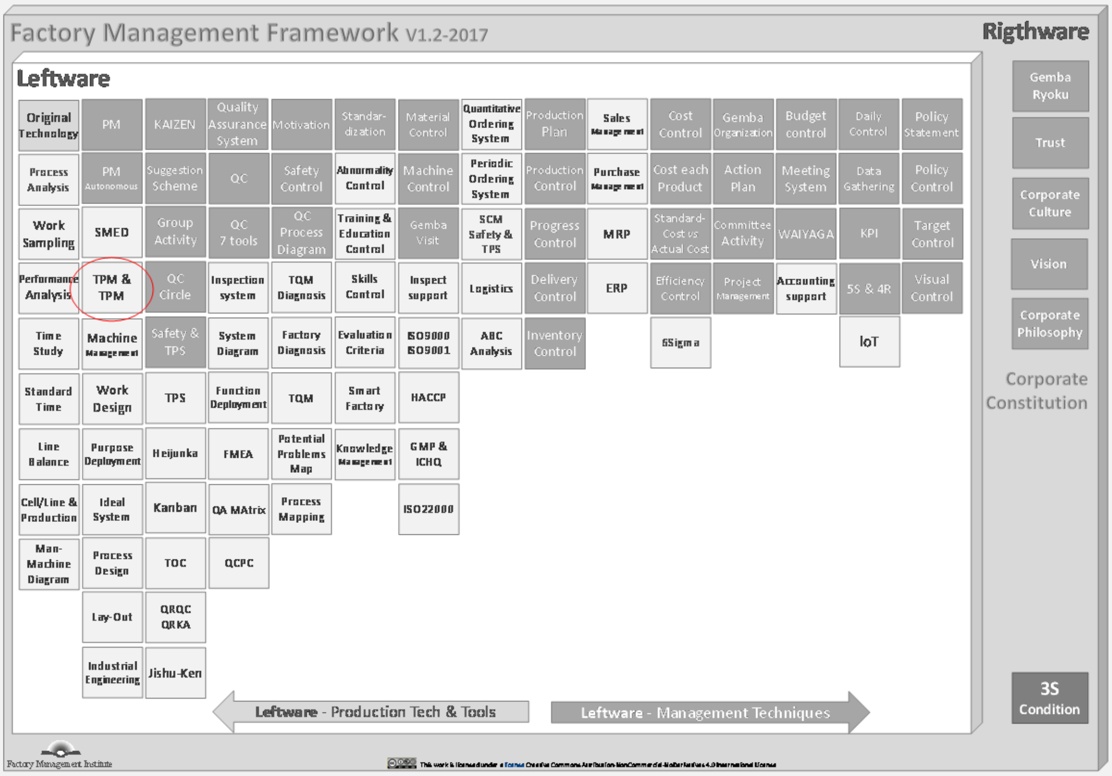
I begin to talk about story of TPM. This story is necessary a little long term. But please accept and listen.

As the Introduction, I describe "What is TPM” and also, I write about Muda (Loss, Waste).

The purpose of TPM is to reduce or eliminate “Muda” with through machinery maintenance. But it is not altogether possible to eliminate any Muda with through TPM.

And I need to write Muda sooner or later. So, please accept me to share the pages for Muda.

There are so many requirement to share the writing of TPM. Then I start to share it.



As the start of this theme, I wrote the next items:

One is what TPM is.

Firstly I give one previous notice.

My writing TPS is not **Total Productive Maintenance**, but **Total Preventive Maintenance**. Of course both are a little different.

I use the material of JIPM to introduce TPM. And in the material of JIPM there is a chronology. And this chronology shows the step of TPM which the steps of Breakdown Maintenance to Preventive Maintenance to Productive Maintenance and to Total Productive Maintenance.

In my experience, I have the feeling of wrongness.

One is the missing of Total Preventive Maintenance. And also I have the feeling of wrongness about the age of Productive maintenance.

I believe there is no such ambiguous age which is Productive Maintenance in Japan.

Another one is about Muda.

Muda (Loss, Waste in English) is quite important concept. And the aim of TPM also to reduce and/or eliminate Muda in machinery improvement activity.

About Muda, there are some different opinions. However the word Muda is Japanese. And when talking Muda, Toyota 7 Mudas are famous and well known in the world. Lean advocates 8 Mudas in adding No.8 Muda to Toyota 7 Mudas.

This thing also I have the doubt and feeling of wrongness.

Koichi Kimura

II. ¿What is TPM?

As you know I counted TPM as one of the important tools of **Factory Management Framework**. Into the frame there is a box named “TPM & TPM”. But... Why 2 TPMs?

I purposely wrote 2 TPMs in the Factory Management Framework. One of them referring to the **Total "Preventive" Maintenance** and the other one is related to the **Total "Productive" Maintenance**. Both are different, but they have the same goal that is to minimize or eliminate “Muda”. The aim of both is to reduce or eliminate Muda (Waste, loss) with through the point of view of machinery & equipment usage.

And... What is “Muda” in the Gemba? So, my definition of “Muda” is

> *“Muda is everything that does not generate value, does not attach value and, does not provide value”.*

In this lecture, I would like to write about the **Total Preventive Maintenance** as a key issue in the Factory Management.

But first of all, what is TPM?

There are many requirements of description regarding TPM. However, there are some TPMs which are Total Preventive Maintenance, Total Productive Maintenance, and Total Productive Management and also recently Total "Predictive" Maintenance.

In this series, I don't involve Total Productive "Management". Because the meaning is unknown or same to Productive Maintenance (in Wikipedia).

At first Total Productive Management has no substance like as lean management (which shows the situation, but doesn't have certain methods itself).

According to the material of JIPM, Total Productive Management is the alternative name of Total Productive Maintenance.

Anyway, the contents of Total Productive Management is ambiguous. Therefore I neglect this from my description.

Sometimes I described the name of Total "Preventive" Maintenance and got some questions, advice or claims that it is a misprint of Total Productive Maintenance. Of course, it is not a mistake and misprint.

Perhaps the word of **Total "Predictive" Maintenance** is your first time to listen. There is the word of Predictive Maintenance in the material of JIPM. But the contents and meaning are different.

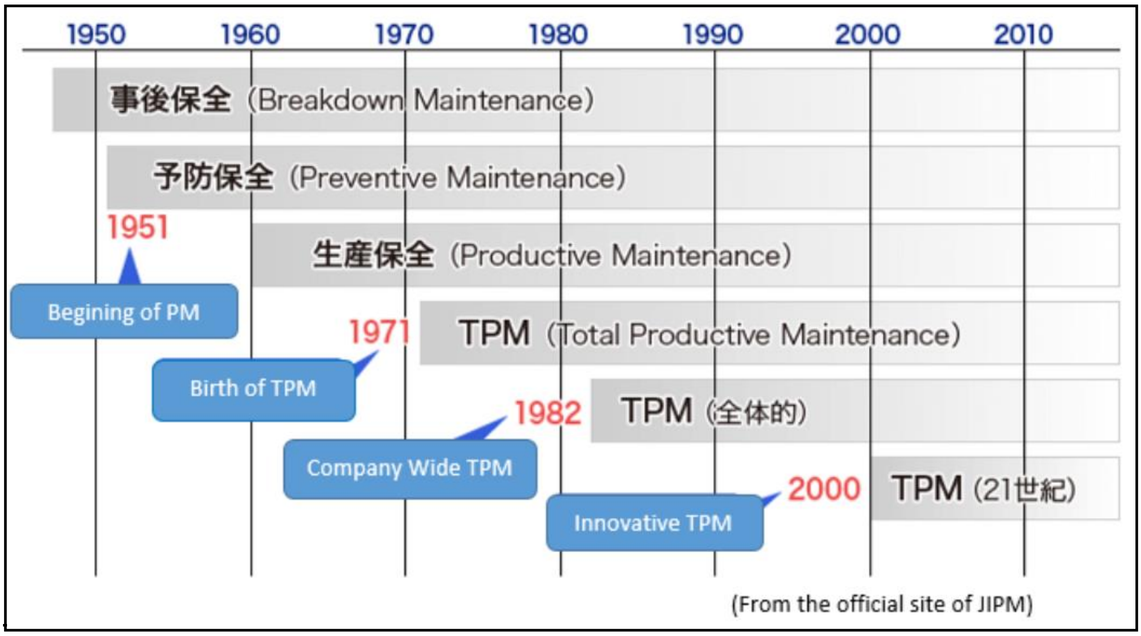
Total Predictive (Anticipatory) Maintenance is the maintenance system in using IoT and AI and Cloud & Edge Computing. I have written IoT in Factory Management-3. Therefore I believe you could understand the situation of Industry 4.0 and 4th Industrial Revolution. And I told that our working fields (Gemba) will change very dramatically with in one decade.

So, TPM also is required to improve the techniques and the concept of using IoT, AI and, Robot and in the new infrastructure of Cloud & Edge[1] computing and in the knowledge required of data science, operational technique.

Then at the moment (2017 July), the techniques of IoT, AI, and Robot are adopted in the field of machinery maintenance gradually. Then in this column, I do not obviate the theme of IoT, AI.

Returning to the main topic, what is TPM? For that, we should name the TPM pioneer, who is undoubtedly DENSO and JIPM[2]. So, I use their materials in appreciation. Let's take a look at the historical origin of the TPM, on the JIPM material:

As you aware, in the history of JIPM there is no Total "Preventive" Maintenance.


1950
1960
1970
1980
1990
2000
2010
事後保全 (Breakdown Maintenance)
予防保全 (Preventive Maintenance)
1951
生産保全 (Productive Maintenance)
Begining of PM
1971
TPM (Total Productive Maintenance)
Birth of TPM
1982
TPM (全体的)
Company Wide TPM
2000
TPM (21世紀)
Innovative TPM

(From the official site of JIPM)

---

[1] **Cloud & Edge Computing:** Edge computing is a method of optimising cloud computing systems by performing data processing at the edge of the network, near the source of the data. https://en.wikipedia.org/wiki/Edge_computing

[2] **JIPM:** Japan Institute of Plant Maintenance. http://www.jipm.or.jp/en/

Yes, this is my point of view and thought. And every time I write the name of Total Preventive Maintenance I was pointed out it is wrong, also I was questioned, why? But I answer that both: Total "Preventive" Maintenance and Total “Productive” Maintenance are different.

But, why? Why do I describe Total Preventive Maintenance?

There are really several reasons based on current situation and current trends. The trend advocated by JIPM shows the jump from Preventive Maintenance (PM) to Total Productive Maintenance (TPM) and there is no period of Total Preventive Maintenance (TPM).

I think there is an intermediate era between Preventive Maintenance (PM) and Total Productive Maintenance (TPM) and that era, corresponds to Total "Preventative" Maintenance, which in the case of Japan, lasts a little more than a decade.

- The objective of **Total Preventive Maintenance** is the **Production Gemba**.

- The objective of **Total Productive Maintenance** is the **Company as a Whole**, which includes the department of staff and indirect.

This page is intentionally blank

III. The 8 Pillars of TPM

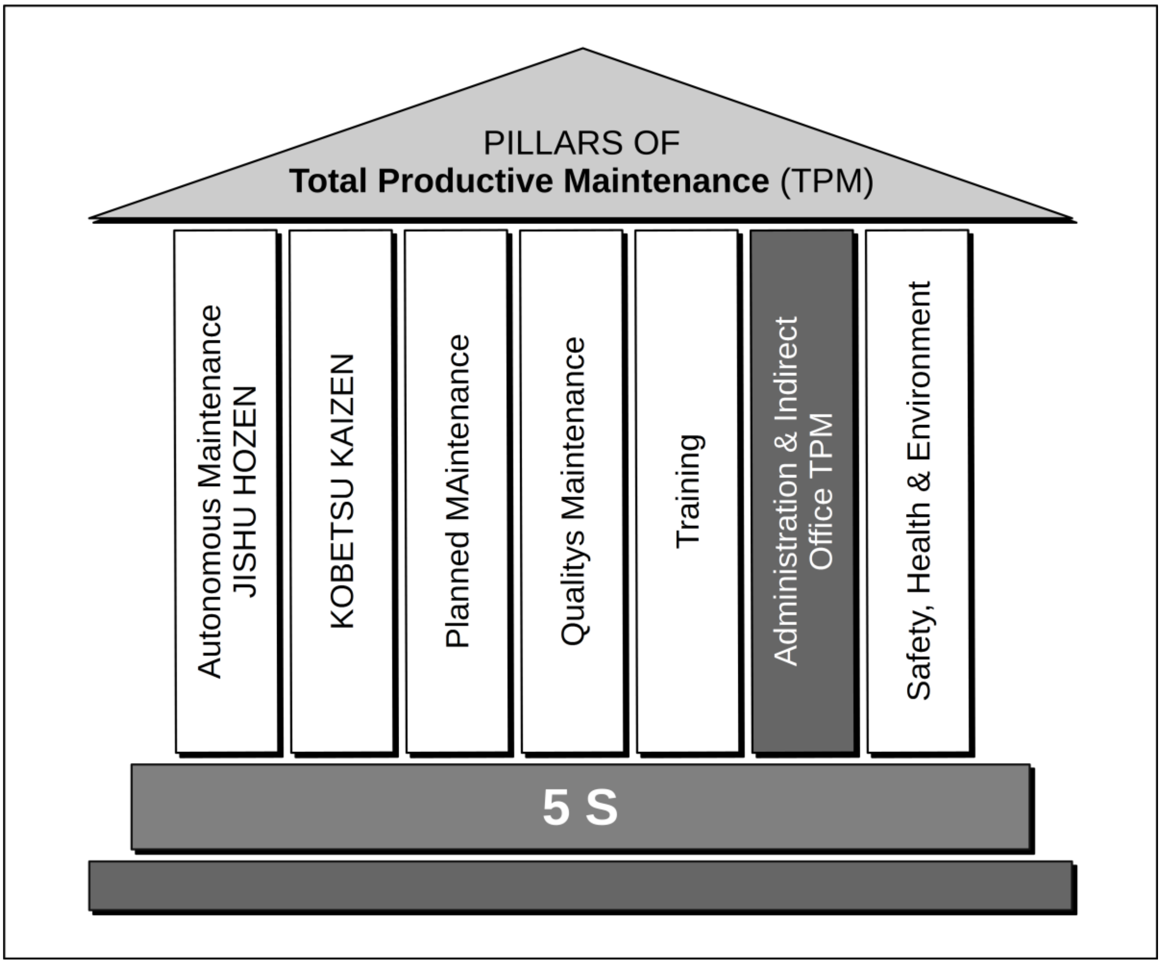
As I wrote earlier, there are many requirements to write about the TPM from my friends. Then I have made the questions to them. What is your thought or image of TPM? And I got their answers in the world.

One of the common point is that all people mentioned the house of 8 pillars. It is indeed that the house of 8 pillars is so famous.

And according to their answers, the aims are almost the same, but there are differences in the understanding of "The 8 pillars of the TPM". And the different point in 8 pillars is the understanding or thought of (for instance) Office TPM.

Actually, the biggest difference between my Total Preventive Maintenance and Total Productive Maintenance of JIPM is this pillar which is Administration and Indirect (Office-TPM).

I do not describe this pillar, but just articles of Gemba related.



The original perspective of the JIPM includes the Administration and Indirect in the image of its 8 pillars. The goal of this pillar is:

- Establishment of the efficient system in Sales, Purchasing and Administration and Indirect departments.

Generally, we imagine that the departments of administration are such Human Resources, Accounting, Finance, R&D, General Affairs, Legal, Planning, Intellectual Property. And the definition of JIPM is involving the above all departments as company-wide TPM.

However, the understanding and image in the world are different. But there are actually three important trends in this pillar:

1. The optimization of the administrative process. The aim is to reduce and eliminate Muda in the administrative departments.
2. The role of administrative departments is to support Gemba to reduce and eliminate Muda in the Gemba machinery maintenance activity.
3. Likely, Total Productive Maintenance is the system of ‘more effective' maintenance (it was indeed most of the friends expressed).

The first factor observed is similar to the JIPM perspective. Thus, Total Productive Maintenance is acceptable, However, how can you imagine to combine Productive "Maintenance" to Administration departments such General Affairs, Legal, Planning, etc? For instance:

—What is the role of the Human Resources department in Total Productive Maintenance?

Yes. I will write the role in Total Preventive Maintenance in the **Education & Training** and **Evaluation**[3]**,** combining with Salary also with Safety.

—What is the role of Accounting?

Yes, I will write the role of providing the cost data to Gemba and suggesting the unit costs[4]

---

[3] **Evaluation, Salary & Safety:** Some links between TPM and HR department can be reviewed into the Factory Management II Policy Deployment & Control where a Personal Challenge Card is developed according to the Annual Policy and achievements of this challenge card is used to establish personnel salary rates.

[4] **The Unit-Cost** was explained in the Factory Management II - Policy Control. It is the basis of budget and visual management in the Gemba. Each KPI displayed in the visual management panels must have its

—What is the role of R & D?

Yes, I will write the development of new products in the article of **Initial Products Quality Control**[5] (IPQC) and the Committee.

In the IPQC, I describe the activity of the committee that includes Quality, Engineering Design, Procurement, Production Engineering, Sales, Supplier Control, Human Resources, Accounting and Finance, Production Control and of course Maintenance and finally the Gemba, focused on a VERTICAL start-up that eliminates the losses in the new products that start in Total Preventive Maintenance.

But I do not touch the point regarding waste reduction or Muda in the administration and indirect departments that the JIPM involves in its TPM because these departments are too far from the issues of Production Gemba.

I never deny the relevance of TPM activity across the whole company, and it includes management departments in the future vision. However, I recommend implementing the Total Preventive Maintenance, which scope of action is only the Production Gemba and the "support" of Indirect Departments.

Therefore my writing is the second one. "The role of administrative departments is to support Gemba to reduce and eliminate Muda in the Gemba machinery maintenance activity".

Regarding the third point: "Likely, Total Productive Maintenance is the system of ‘more effective' maintenance". In fact, most of the friends mentioned the nuance of "Better Preventive Maintenance and/or More Effective Maintenance System". They never are ignorance of TPM and know the 8 pillars and the contents without one pillar which is the "Administration & Indirect"

—Does Total Productive Maintenance mean "more effective maintenance"?

It is quite natural and understandable, because of the word "Productive", which is a word that adjectives and means something similar to "marked by a great fruitfulness". It can be used, for instance, in a productive vineyard, productive years, etc. But, in the sentence: Productive Maintenance?

---

translation at a Unit-Cost so that the Gemba understands its real impact and they could plan improvements on the actual impact of each variation.

[5] **(IPQC)** *Initial Products Quality Control, First Article Quality Control (**FAQC**), Advanced Product Quality Planning (**APQP**) and Production Part Approval Process (**PPAP**), there are many different denominations and acronims for similar approaches. IPQC is the original and complete method of all of them.*

—What is the meaning of Productive Maintenance?

—What is the level of productivity required?

Undoubtedly, this adjective is ambiguous:

- "**Productive**" is an adjective to show a situation, and;
- "**Preventive**" is an adjective to show an act the "**act of prevention**".

I have had a similar conversation with my friend. He asked me what Lean is and what specifically Lean Management is. And I jokingly replied that the meaning is probably a "**Skinny and Poor Management**". And that the sound is good, but the content is empty.

It is not necessary to be particular about naming, but it is true that the word "**productive**", causes unnecessary confusion and misunderstanding.

By the way, the book of the **Toyota Production System** written by **Yasuhiro Monden**, in its first edition of 1991, is famous in the world. In this book, the concept of Total Productive Maintenance is introduced. However, the Japanese explanation is "**Machinery Maintenance in All People's Participation**".

In some books of the JIPM, TPM is explained as "**Keep the production in good condition**". This definition is, likewise, ambiguous.

I appreciate expanding the loss improvement activity in companywide with the name of Total Productive Maintenance after the good level of Total Preventive Maintenance in the Gemba. But to follow the step is important

In the first place even Denso, there is the evidence of the implementation of Total Preventive Maintenance in Gemba for a long time. And after this period he expanded the activity to companywide.

My understanding of Total Productive Maintenance, including management departments, is the next step for the company that could have the capacity and sufficient level of "All People's Participation (Production Gemba)" in Maintenance, and then, it may be expanded to all the other departments.

Unfortunately, outside Japan, I haven't seen such level company yet as written below. And I recommend following the step which is PM as first and Total Preventive Maintenance second and as final stage Total Productive Maintenance

IV. Learning to TPM

In Japan, there is a word: "**Shu, Ha, and Ri**".

Originally this is the word of Noh[6] which is the traditional Japanese art and is the oldest theatrical art in the world and it has been continuing more than 1,300 years. It is original from China and it arrived in Japan in the Nara period around 700.

This thought is still the base of the innovative process of the "tea ceremony", martial arts such as Judo, Kendo and the “Art” in general in Japan.

- **Shu** (守): Shu means "**to keep**". To Keep Kata[7], that is being taught by the teacher. Anyway, it is necessary to master the Kata which is like the form of Judo. This step is still training level.
- **Ha** (破): Ha means "**to break**". After keeping Kata taught, the next step is to analyze and study for him/her self and create better Kata.
- **Ri** (離): Ri means "**to go away**". To understand deeply the Master's Kata and his/her own Kata. And free from teacher's Kata and his own Kata and break new ground including the philosophy.

And figuratively speaking, of our work, regarding the levels **Shu, Ha, Ri:**

- **Shu:** It is the level of which he can complete its job by himself;
- **Ha:** He can improve the job in analysis and improvement activity;
- **Ri:** He can develop new knowledge and methods as creator.

It is not possible to be on the level of Total Preventive Maintenance without the basic condition of Preventive Maintenance (PM). And it is not possible to be the level of challenging Total Productive Maintenance, throughout the Company and including management departments, without Total Preventive Maintenance, which focuses on the Production Gemba.

---

[6] **Noh** (能 *Nō*), or **Nogaku** (能楽 *Nōgaku*)—derived from the Sino-Japanese word for "skill" or "talent" https://en.wikipedia.org/wiki/Noh

[7] **Kata:** In Japanese language kata (though written as 型) is a frequently-used suffix meaning “way of doing,” with emphasis on the form and order of the process. Other meanings are ”training method” and “formal exercise.” The goal of a painter’s practicing. https://en.wikipedia.org/wiki/Kata

1) When introducing TPM… How shall I do?

When I teach the introduction, I do both parallel jobs.

1. **Making the base of the PM with the engineers.**
2. **Making committee activity (5Ss and Safety) with Gemba Workers.**

I will describe the details about both those in this series.

When I am required to introduce Total Productive Maintenance, how shall I do? ... Simple, I refuse the customer's demand and I tell to him:

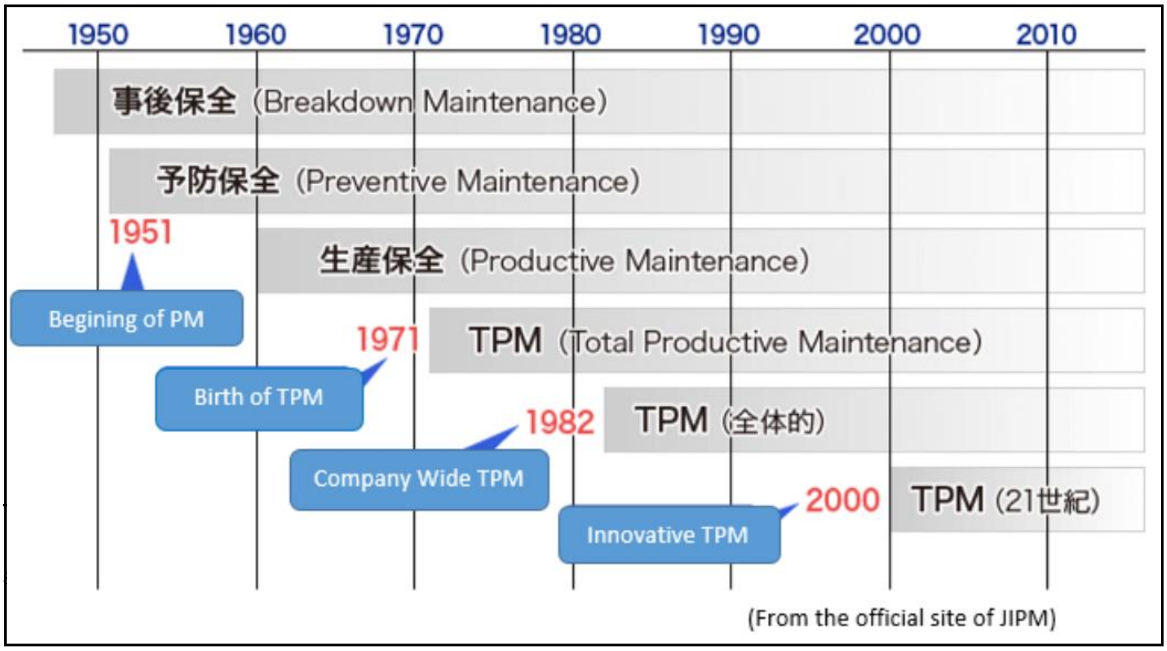
—Your target to introduce Total Productive Maintenance which is the highest level of TPM. And I believe you have the capacity and you are at a sufficient level of Total Preventive Maintenance. Therefore, you do not need my support and you can do it by yourself.

Again the chronological table below.

There are 2 items of Total Productive Maintenance. One is from 1971 and another is from 1982. And my understanding is that the first TPM refers to Total Preventive Maintenance, which focused on the Production Gemba. In here a little more I refer to the timing. Because above timings are the excellent companies case such Denso, Toyota, and others.

As you know the thought of Preventive Maintenance came from the USA at (may be) 1951.

When I joined my previous company[8] in 1968, there was the system of PM already, But still, it


1950
1960
1970
1980
1990
2000
2010
事後保全（Breakdown Maintenance）
予防保全（Preventive Maintenance）
1951
生産保全（Productive Maintenance）
Begining of PM
1971
TPM（Total Productive Maintenance）
Birth of TPM
1982
TPM（全体的）
Company Wide TPM
2000
TPM（21世紀）
Innovative TPM
(From the official site of JIPM)

was very far from the Total Preventive Maintenance in the concept of "**All people's participation**".

At 1971 we started the 1st project of Toyota production system introduction in the teaching of Suzumura group. However as I wrote in Making Stream of Production, it was finished in failure. At that time the level of machinery maintenance was still poor PM level which was "Operator is the person who breaks the machine and the maintenance engineer is the person who repairs".

I wrote that the introduction of Kanban system in Suzumura teaching was failed. But there was a good thing which was the start of self-education of 4Ss (5Ss, and in SUMITOMO 6Ss). The start of 5Ss activity was this timing. And.

At 1971, my previous company was the level of 5Ss introduction.

At 1980's I could establish **Total Preventive Maintenance** with

1. **Daily & weekly & monthly checklists by operator,**
2. **Standardization of simple maintenance & repair by operator,**
3. **Maintenance training of autonomous repair & education & evaluation system in reasonable 5Ss and "All people's participation" level.**

And all of these built over a reasonable level of 5S and "A**ll People's Participation**".

2) How about the situation of foreign countries?

At **1973** I was in Mexico teaching to the Mexican Branch of Packard Electric (now Delphi). At this time the level of maintenance was still "**Breakdown and Repair**"

At **1990's** it was in the UK. Initially, the level of maintenance was still somehow a precarious preventive maintenance (PM) and the situation was still "**Breakdown and Repair** ". Then one of my jobs was to prepare certain PM. And in the teaching of Factory Management, I also taught Quality Control Circles to cultivate the Kaizen mind and also the mind of "**All People's Participation**"

At that time, the machinery was shipped from Japan was easily damaged due to the limited and poor education of the operators in their maintenance.

And the level of thought was still: “Operator is the person who breaks machine and the maintenance engineer is the person who repairs”

I remember that I told to managers:

— A machinery is not to break but is to be broken by the operator.

Of course, the operators did not willingly break the machine and they adjusted the machines in their own way. They knew the condition of the machine very well, but even they felt some abnormality, such as a noise, vibration, heat or abnormal odor or even any other abnormality, they did not report to the maintenance section, before serious breakdown and stop.

The necessary jigs for set-up and adjustment were chained with steel wire to avoid to be stolen.

ANDON was very popular in that timing. Each machine had the ANDON system to inform the machine running situation. But this system was used as a call-signal for the maintenance engineer after the machine troubles.

At 1990, the above chronological table shows the period in which TPM is extended to the entire company. However, one of my previous companies, at that time Lucas SEI, was still in the pre-Preventive Maintenance (PM).

In 1998, again I was in Mexico again, and out of there, the level of maintenance of the main factories was still an initial level of Preventive Maintenance. And when the machine had problems and stopped, the operator called the maintenance engineer, and during the repairing, the operator was just waiting for him and repairing, the operator was just waiting in doing nothing and standing by.

To improve the situation, I introduced the Quality Control Circles and 5S activity in Gemba to achieve the "All People’s Participation". It was succeeded and Gemba people participated in these activities positively.

The Mexican workers also welcomed the activity of thinking and creating, leaving for a small moment the physical work during the completion of the Quality Control Circles. But when I tried to begin the implementation of Total Preventive Maintenance, the problem arose with the labors union. Actually, the company had no union, but there were similar pressure groups.

The group of maintenance technicians expressed their complaint about the violation of their territory of action. They worried about the sharing simple maintenance job to the machine operators as to be trespassed on.

I expected the machine operators to make the simple maintenance job as the initial stage such daily & weekly maintenance check sheet, regular oiling and Seiso which 5 minutes Seiso of his machine and finding the irregularities such looseness, rattling, lack of oil and/or lubricant, shavings, and dirt.

On the other hand, the machine operators group required the increase of salary, because of the job range expansion even though in the initial stage of TPM. Of course, as the second stage which is an evaluation of maintenance skill in 5 ranks, we planned to feed back to their salary based on the skill audit result. In fact, it was very much difficult to change the job range. For instance, one day my staff made time study and intended to change the worker's job range for adjusting the line balance. But the worker whose job increased 5 seconds left next day.

Another problem occurred, when the jigs and tools were stolen quite often. And the situation was helpless. But, at 2002 the situation of Mexican workers was still on the same level and, one of the causes was poverty.

Now 2017, and according to my friends, the situation of factories are still PM level which is:

1. The operator just operating machinery and no participation to PM.
2. Trouble repairing, solving and PM are the job of maintenance technician.

Shu -to keep.	This is the level at which you can complete your work for yourself;
Ha -to break**.**	You can improve the work in the activity of analysis and improvement;
Ri -to go away.	You can develop new knowledge and methods as a creator.

In 2003 I was in Malaysia, Vietnam, and India. These countries were different to Mexican operation. The workers of these countries also poor. But there was no helpless situation.

Why do I write such historical things and the current world wide situation? Because I'm concerned for the world wide misunderstanding and confusions.

It is quite true that there are many companies who achieved the level of company-wide TPM which aims to reduce Muda in not only the production Gemba but also in the department of administration and is the stage of "**Ri**".

But actually, general companies in the world are still in the stage of PM or initial stage of Total Preventive Maintenance, because of the difficulties of Gemba people's participation and involvement.

On the other hand, only the name in the book of Total Productive Maintenance with 8 pillars advances. Then I recommend implementing the stage of Shu (PM) and Ha (Total Preventive Maintenance) rather than Ri (Total Productive Maintenance).

After this, I write TPM based on my experience on how I provided the TPM in these foreign countries and Japan, and how I succeeded or I got the difficulties.

I dare to add one thing: Please leave from the word of **Total "Productive" Maintenance**, because there is the trend of using or requiring this in no fundamental condition, in not to follow the necessary process and in no corrective knowledge. Therefore after this, my description is Total Preventive Maintenance.

Shu (To keep)	**Preventive Maintenance-PM;**
Ha (to break)	**Total Preventive Maintenance-TPM;**
Ri (To go away)	**Total Productive Maintenance-TPM.**

So, TPM in Administration and Indirect? Please, forget this.

V. PM ‘vs’ Total Preventive Maintenance & TPM

Now I will describe the comparison between PM (Preventive Maintenance), Total Preventive Maintenance and finally Total Productive Maintenance.

1. **Preventive Maintenance (PM)**: Maintenance activity before broken. The role is made by just maintenance engineer but still, is not involved the machine operators.

2. **Total Preventive Maintenance:** The role is shared for Gemba Workers and Maintenance Engineers.

   The range of horizontal activity (the processes) is from R&D → Production Planning → Production → Shipping.

   The vertical activity range (the organization) is involved in Engineering Design, Production Engineering, Quality Engineering, Procurement, Sales, Accounting, Human Resources, Production Control, Subcontracting, and Production Gemba.

   But the role of administration and indirect departments, in the above structure, is not to be involved to reduce Muda in their own process, but to support the Production Gemba. And the aim is to eliminate and reduce Muda in focusing machinery in a persistent manner.

3. **Total Productive Maintenance:** Companywide Muda reduction activity. And actually, it is Total Preventive Maintenance (Gemba) plus the activity of Administration & Indirect to reduce Muda in their own process.

   Normally the reduction and elimination of Muda in administration & indirect departments are planned separately from production Gemba.

   And in this case, the "Muda reduction activity" is not planned on the extension of the Total Preventive Maintenance, but is planned (for instance) in the company-wide rationalization plan. Because each of the approaches is different. As I wrote earlier, the purpose of TPM is to eliminate or reduce Muda.

   And, as I mentioned in the introduction to this TPM, Muda is equivalent to lose or waste. But first of all, I need to be excused. Of course, the goal of TPM is to reduce or eliminate Muda through its activity. However, TPM activity can not altogether eliminate any Muda in the Gemba.

VI. Muda

We consider Muda in the point of view of PM and TPM

When I was the leader of one Jishu-ken, my group asked me the definition of Muda, and I was annoyed by this question in a Jishu-ken.

At that time my factory was doing the campaign, and the activity slogan was "**Let's elimination of 3Ms in the improvement**". 3Ms: Muri, Mura, and Muda. (Temporal understanding)

- **Muri:** The thing or state which is not reasonable. For instance, giving 200 of workload for the capacity of 100.
- **Muda:** As an example, giving 50 workloads for a capacity of 100.
- **Mura:** The phenomenon in which appears the situation Muri and Muda randomly. A bad or poor condition of factory control.

However "Muda" has been translated into English as Waste or Loss.

Firstly I checked the meaning in a Japanese dictionary and confirmed it as follows:

- **Muda:** Useless things (Phenomena) and things (Substances). Things without benefits. There is no value merely to do it. An example is a Useless expense. The effort is wasted.

“Muda the things which don't add any value to the products "directly".

And I taught my definition of Muda as follows:

And ... why “directly”?

I describe some examples... Have I written "is 5Ss Muda?" or, in the column of Making Stream of Production.

In 5Ss, there is the item of **Seiso**. Seiso itself doesn't give any value to the products. However, it gives good influence to the products "indirectly". But it is categorized in Muda which means Seiso itself also the theme of Kaizen improvement. Therefore the item of Seiketsu is necessary. Seiketsu involves Kaizen for keeping Seiri, Seiton, and Seiso. (Later, a little more I describe it.)

But my **Jishu-Ken** group still mentioned their doubt about it.

—Why Taiichi Ohno define "Transportation" as Muda? When transportation is essential for production, business or everyday life —they questioned.

—But transportation by itself does not add any value to the products. And therefore, it is categorized as Muda. But it is necessary. It is said to be "a necessary evil." Then it is one of the targets to improve.

But still, my group did not consent to my explanation.

—But it's a necessary Muda. Why? And, one necessary evil?

— Sensei told that Muda is the things which don't add any value to the products "directly"…

—And 5S also "a necessary evil"? How about the morning meeting, or the shift-meeting? Are there any meetings Muda? Are they also categorized in Muda? And... The job of indirect sections may be also Muda, because of not adding value to products?

—Is the Accounting Department also Muda? Or, is any Administration Department also Muda?

I was listening to their debate and at well-timing, I stopped their debate and taught as follow.

—Firstly: **Muda is the things that do not add value to the product "directly”.** Therefore this definition is for a production Gemba, and not including an indirect section or administration department…

—And secondly: The essential elements of the composition of a company are Sales and Marketing, Production and Management or Administration. And production ranges from R&D to production and shipping —and I continued...

—And your debate mixes the Production Gemba and Administration Gemba, Is the job of Accounting Muda, just because of no adding value to products?... Of course not. Of course, it is wrong and the job of accounting is not to be categorized as Muda because the products produced by the Accounting Department are "DATA".

—Firstly, accounting must provide necessary and required data in necessary timing and in good accuracy (quality)…

—And secondly, accounting also is required to improve for providing "necessary data in necessary timing and good accuracy" in reasonable cost.

—Furthermore, in a factory there is one organization and, there is the Factory Manager position. But... is Muda the Factory Manager, just because the definition is that it does not add value to the product? Of course it is a misconception and it is not Muda.

Again 5S. Is Muda the activity of 5S? Of course, it is not. The total activity of the 5S is implemented under management requirements. However, Seiso has different characteristics.

I have written another argument in the series of “**Making Stream of Production**”. Is Muda the 5S activity? And, at that time, I wrote: "**Muda are things that do not give any value directly**."

Another example appears in 5Ss. Seiri (Separation in Standard) and Seiton can be done with no additional cost. However, in the activity of Seiso is necessary to spend cost.

What is the effect of Seiso? One of the opinions that are heard is always related to "quality". But, does quality really improve by Seiso activity? Or is there a cause and effect relationship between Seiso and Quality?

Please, let me write another true story about 5S.

In the foreign factories, manager, and supervisor required to reduce or stop Seiso temporally to prioritize the production and said:

—The activity of 5Ss is Muda because it does not give the value to the product directly. Rather than the 10 minutes stop for Seiso, it is important to increase the daily production for us. 10 minutes is equivalent to 2% of labor efficiency. We are required to reduce Muda and improve labor efficiency. We are required to keep daily output…

—Today it is very tight on the schedule. Today we cannot stop the line for Seiso. Sorry to say to be Muda is my overstating. Nevertheless, why every day? Why not is Seiso performed on the machine every 2 or 3 days? —said the production supervisor.

Now, you are a top manager and as a top manager do you accept their requirement? Do you accept this compromise? And eventually... **This is how the 5Ss stability fails**.

It is wrong to categorize 5Ss to be Muda even though it doesn't give any value to the products directly. The Output of 5Ss is a good managerial condition.

Production Gemba workers also can and, need to participate in corporate management. And they can do it with through not only the production but also the Gemba autonomous activity such Ss.

And as corporate management, it is necessary to cultivate the mind of "**All People's Participation**". And 5Ss activity is one of the essential means to achieve that. In order to reduce Muda in Gemba, it is a good idea to implement 5Ss activity.

As I wrote, when thinking Muda, it is necessary to consider from the point of view of production and management (administration).

---

*Muda is everything that does **not** create value; does **not** accompany value, and does **not** add value".*

And finally, the conclusion of the group was that "Muda in the Production Gemba is":

Saying Muda is like saying the famous 7 Wastes in TPS and 16 Wastes in Total Productive Maintenance

And again I need to tell you at the first time that it is not altogether to be possible to resolve all kinds of Mudas with Total Preventive or Productive Maintenance even though its aim is to reduce or eliminate Muda with through machinery maintenance.

Now, for your reference, I present both concepts of Muda.

1) The 7 Muda in TPS.

As you know, TPS defines the following 7 Wastes.

1. **Over-Production;**
2. **Waiting;**
3. **Transport;**
4. **Over-Processing;**
5. **Inventory;**
6. **Excess Motion and;**
7. **Defects.**

Over-production: It is categorized as the worst Muda. Even though to be overproduction, the parts or material have the opportunity to be used and to be changed to the value.

But... Why is it be categorized as the worst Muda? Overproduction causes serious problems of Increase of handling, excess capacity of machinery and labor, additional space and control, material stock increase, unnecessary procurement. And the opportunity of dead stock and defect products increase.

Waitings, Transporting & Excess Motion: None of them add or give value to the products or customer.

Defects: Defects not only to not add value but also to be required the cost of repair, additional inspection, and additional materials and/or scrap cost.

Inventory: There are the opportunities to use or to sell. But why Inventory is categorized in Muda? Because. The increase of handling, additional space, and control, material stock increase, increase of dead stock opportunity. And also a serious problem which is to worsen the Cash Flow.

Excess Motion: Muda by excessive motion is kind of: Why is he walking? Or, look! He dropped the tool and picked it up again. Why do you need to lengthen his arm? He doesn't use both hands at work. He put the work on the table and picked it up again. Why does need to stretch the arm to take the tool? Does he need to take the difficult posture?

As you understand, the problem-solving tool of Excess Motion is Industrial Engineering (IE). Taiichi Ohno was the person who was very keen to "Profitable IE". And above examples are the matters of IE.

Then in here, I would describe the case of Over-Production and Over-Processing in my experience.

Overproduction

In TPS over-production is defined as the worst Muda. So, what is Overproduction?

Over-Production is to produce products or parts or materials more than the "pull" or the "pull" of the customer of the following process, by ignoring the Standard Stock or the Standard Inventory.

One day I was invited and was asked a lecture by a medium class company. In the way of the factory tour, I got the Gemba presentation in a parts fabrication line of the model factory. The supervisor made his presentation with his machine performance chart in front of the new machines which about 8 months have passed since the installation.

The machines showed good movement and performance as the supervisor presented them.

After the tour of the plant, we moved to the conference room. And in the conference room, I was asked for some comments about the impression of the visit of the plant. It is very natural that I am required and comment on it.

Below I transcribe the recreation of the conversation with the president, directors, and managers.

—Sensei how is your impression and comments on our model factory. We intend to expand the model factory methods to all other factories —said the president.

—Yes. It's a clean and tidy factory —I said coldly.

—And? —asked the president, somewhat surprised by my frosty reaction.

—Mr. President, I would suggest changing the subject of my conference today, because I felt a very serious concern about the model factory —and I continued...

—Today's meeting and the conference are about introducing the **Toyota Production System**. But I would suggest doing a **Jishu-ken**[9] on the subject of "**Over-Production or Making the Stream of Production**" —I mentioned some concerned, and I kept talking...

—As you know, TPS defines 7 wastes. And over-production is the worst Muda. It is a quite good opportunity to make the Jishu-Ken rather than my lecture. Is it agreeable for you? —I asked finally.

—Yes of course. But why is the model factory so serious? —asked the president.

—Mr. President, from now on, please keep quiet and do not make comments for a while. And now, before moving to the managers Jishu-ken, let's make some conversation —and I started to ask the presents.

— First of all, Mr. Sales Manager, please tell me one thing. What was the sales trend of last year, the current situation and, the future prospect?

—Uhm… There is a slight variation, however, there was no remarkable change in sales results. There are good prospects for the future —the Sales Manager said after checking the data sheets—. There is a good prospect in future. No, not only future but now also. It is possible to increase the sales amount more than 30%.

This figure was shared by all managers.

—Your Company is so happy, aren’t you? There was demand and there is still more demand. But eventually, a number of sales are not increased finally. —I asked finally—, why?... Think about it, please. Why?

—I think it is the question of the production capacity, obviously of the machinery —said the Production Manager.

---

[9] **Jishu-Ken:** Intensive improvement session between supervisors and managers, until the result or a solution to the problem faced. Only with occasional breaks, last what lasts and until reaching a consensual solution.

—Good. Capacity Shortage to current demand and future demand. And? —I asked.

—Therefore, we bought and settled the new machines that you saw in the previous presentation —answered again the Production Manager—. These machines supply the parts to the next several lines.

—OK. You solved the shortage of machinery capacity, is it true? —I asked—. But the number of sales did not increase in the past 8 months. Please, sir —I said to the Production Control Manager—, please let me know what is the next month's production prospect and forecast related to the new machines and the lines.

—The production schedule per day does not increase. We discussed with Sales Department and decided the forecast in this way —he answered.

—Can I understand that the investment on the new machines did not contribute, or in other words, were not effective for increasing sales? Am I right Mr. Accounting Manager? — I asked—, Mr. Accounting Manager how about the movement of fixed cost?

—The movement of fixed cost was of course increased, because of the increase of depreciation of new machines investment. Additionally… Please listen everyone —said de Accounting Manager—, one of fixed cost is labor cost. The labor cost didn't change and is in the range of variation which means that the new investment doesn't affect to the labor cost reduction even though the report of efficiency increase. —He mentioned knowing in this way, that the Company applies the idea that the depreciation related to production is one fixed cost.

One Hot and Cold argument…

—The machine performance and labor efficiency are increased —Production Manager said.

—The sales department works well, but cannot increase due to insufficient production capacity —Sales Manager replied.

—There is the production capacity sufficiently. Therefore, it is possible to increase the sales. —Said the Production Manager.

—The profit of our company decreased —answered de Accounting Manager.

—Machinery Scrap and Built is necessary —replied the Production Manager.

—Do we abandon the machines that are already finished the depreciation? —Asked Accounting Manager and he answered himself—. Which is stupid! The old machines still work well at zero depreciation cost. And the inventory turnover got worse.

—Good everyone, Good argument —and I finally asked the Production Manager—. Now, please sir, what is Efficiency? You said you had increased Efficiency, right?

— I understand Sensei, the Efficiency calculation is **Efficiency = (Output ÷ Input) x 100**. And, Output should be sales amount or pull amount of next process. —said the Production Manager and he continued—, I was wrong and I intended to increase the Output of the machines process.

—No, sir — I said to the Production Manager—. You are not altogether to be wrong. However, you mistook the judgment of "Partial optimization and Overall optimization". The improvement of the machine process is one of Partial Optimization. It is important. And the consideration as a total process including sales is the Overall Optimization which is also important. Also, the investment is not critical, because there is optimistic demand prospect, and it (the investment) is possible to change to a good prospect. Therefore I suggest changing the direction of the project a little. —I continued…

—Now please, somebody makes volunteer. Please make the conclusion of this discussion until now. Somebody? —I finally asked.

—Let me do it, Sensei —replied the Accounting Manager—. I have a responsibility to do this because my department is Accounting and has 2 basic functions in this company. One is of course accountancy. And another one is the finance…

—Everyone as you know the job of accounting is the management of money which already moved (used). On the other hand. The job of finance is the management of the money which to be used from now and to suggest the investment priority of corporate resources. From the point of financial view, I need to conclude whether it (the investment) was correct or not —said the Accounting Manager.

— OK please let's do this quickly. Because still, this discussion is on the way —I ached because we had been about 40 minutes spent including the conclusion had to come as next.

—The conclusion is; the investment doesn't effect to profit & sales increase. Inventory turnover, including WIP, got worse. The cause of production capacity shortage is the line balance. The bottleneck is not the manufacture of parts with new machinery, but now the following lines. The existence of the bottleneck is one of the causes of the Stagnation by Overproduction in the machinery process. —the Accounting Manager continued…

— Therefore the necessary countermeasure is to resolve the capacity of the bottleneck process. It is no meaning to increase capacity in other processes without improvement of the bottleneck process. —concluded the Accounting Manager.

—OK, I understood —I said—. Any way you invested to buy the new machines and installed. But unfortunately, the investment is not effective so far. And it is required to change the direction of this project. How can we do it? —I asked and I replied again after a little waiting...

—One suggestion is to make "**Jishu-ken**" with this group of managers on the subject of "**Making Stream of Production**". Now, that you understand, unfortunately, the stream of your production is stagnated. But, before your "Jishu-ken", I would make a brief conference for your reference.

And the conference began by mentioning my concern about what Overproduction means.

—When I looked around the factory, I found the serious problem which is the numerous workpiece (WIP) which were produced with the new machines in the lines side and warehouse. It is quite clear that there is the problem of Overproduction by the parts fabrication process. Why? Why does occur the overproduction?

—Now, I wish to make the talking about 5Ss. And first of all, **Katazuke**[10]. Your faces tell me you know very well 5Ss. But please listen. In the line side, I made a question to the worker:

> *—Excuse me, sir, do you need these workpieces?*
>
> *—Yes, sir, these are necessary and I use in my process. I'm using this lot now. And that one for tomorrow. And the other ones are for... well, I don’t know, but I'll soon use them.*

— Everyone. You told me that you are doing 5Ss. Yes? —I asked—. And if so, what is the standard stock? Because there is no identification of it in that line. No stock or inventory standard needed —I mentioned—. Please understand that the situation is not to say the implementation of 5Ss, but to say simply tidy up. And, how different is Katazuke from 5Ss?

— I imagine you may say to your children, tidy-up your room, tidy-up toys and books! And your kids tidy-up their toys and books in the designated box or places. The definition of Katazuke is:

- **To separate necessary and unnecessary things.**
    a. Unnecessary things to be thrown away.
    b. Necessary things to be put in the designated area.
- **And Clean-up.**

—Your activity is not 5Ss, but a simple Katazuke. Although, of course, Katazuke is relevant. But your factory is required to do 5S. In the 5 elements (Seiri, Seiton, Seiso, Seiketsu, and Shitsuke[11]), the most difficult element is Seiri —and I continued speaking...

—**Seiri** is not merely an act of separating necessary and unnecessary things but requires **Standardization**[12]. In the standard, the elements of What (Things), How many (Quantity), Where

---

[10] **Katazuke**: In Japanese means "to Clear Up", "to Tidy Up". And it is a phase of initial implantation of the 5S in the method of the Master Kimura.

[11] **5S-1 & 5S-2:** Please read the details in my both 5Ss lectures.

[12] **Standardization:** The process in described in “Making the Stream of Production”.

(Location) and When (Time) are required. The child's room does not require standardization, but a Production Gemba requires it for management.

—And now, we come back to the definition of Overproduction —I continued—. Overproduction is to produce products or parts or materials more than customers pull or pull of next process in ignoring standard stock or standard inventory.

—Somebody pointed out that the inventory turnover got worse remarkably. But why? Why were WIP and Inventory increased? Why are there many stagnations? Why does the production stream stagnate? Why does Production Control department let the machine operators produce unnecessary workpieces? What is the standard of parts production order fabrication? —I asked.

—And now I'd like to spend a bit of time on the Kanban[13] system, —I decided to clarify—. You intend to introduce and apply TPS and Kanban system. And Kanban system is a good way to avoid Overproduction and to promote JIT. However, and firstly, the Kanban system is compatible with WIP (Work In Progress) and/or inventory...

—Then the minimum stock is controlled with Kanban. The Kanban system itself is standard in the Production Gemba. And this Kanban is calculated based on the forecast. Of course, the Kanban number calculation is standardized...

Again in the discussion, there was the point of view which the Inventory Turnover got worse. Also, in fact, many workpieces (WIP- Work In Progress) stagnate in the process and warehouse. Probably, there was the change of the working order calculation after installing new machines.

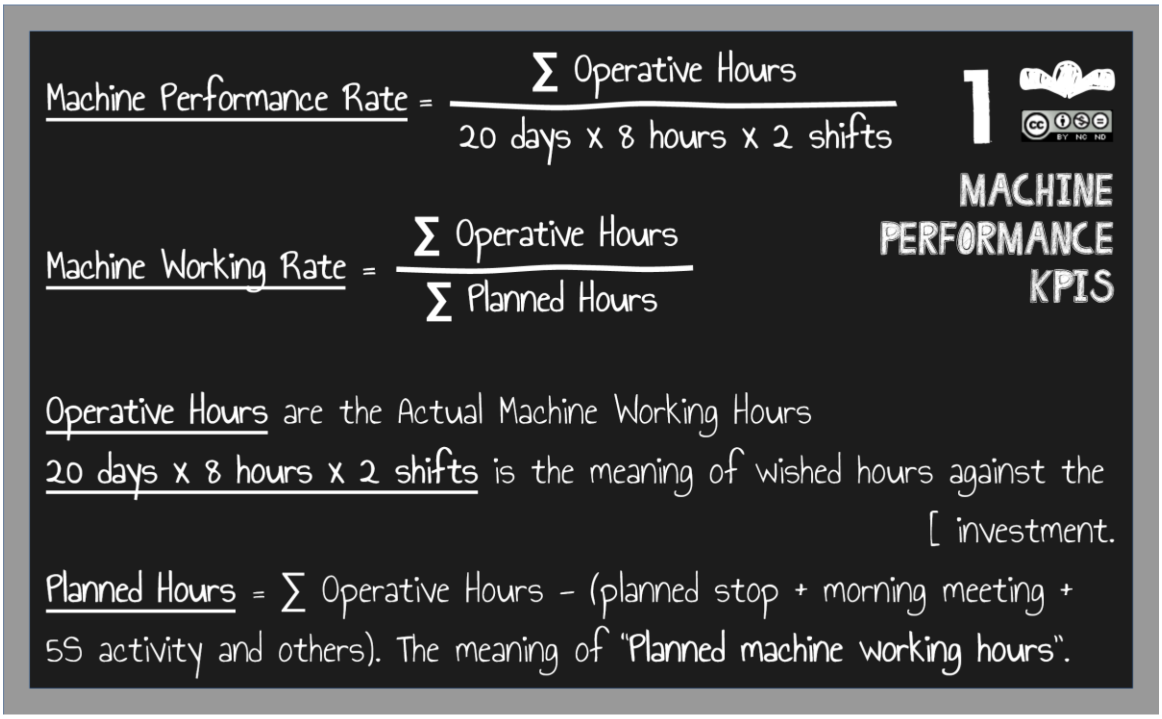
—And now I'll talk about **TPS** and **TPM**... You all know TPM, right? —I asked—, and the base of the TPM is PM. But… **“TPM teaches to avoid stopping the machinery".** And on the other hand, —I questioned myself— **“TPS teachs to stop the machinery[14]".**

— Thus, it is possible to say that TPM controls from the point of view of "machinery" and it is controlled with the Machinery Performance KPIs —and I transcribed them to the blackboard...

---

[13] **Kanban:** Please read my description of the Kanban system in "Stablish the stream of production-13"

[14] **TPS** teaches to stop the machinery because its fundamental goal is to minimize the Overproduction that is cause and fundamental effect of Muda. If a machinery does a job that the next step does not need immediately (It does not pull), this process generates an unnecessary inventory and must be stopped. In the first sentence: "TPM teaches to avoid stopping" is an intransitive verb. That is to say it requires mentioning the direct complement (The Machinery), however in the second sentence: "TPS teaches to stop ..." is a transitive verb that does not require complement to give meaning to the phrase (Therefore Stop if you do not need anymore)



1

MACHINE PERFORMANCE KPIS

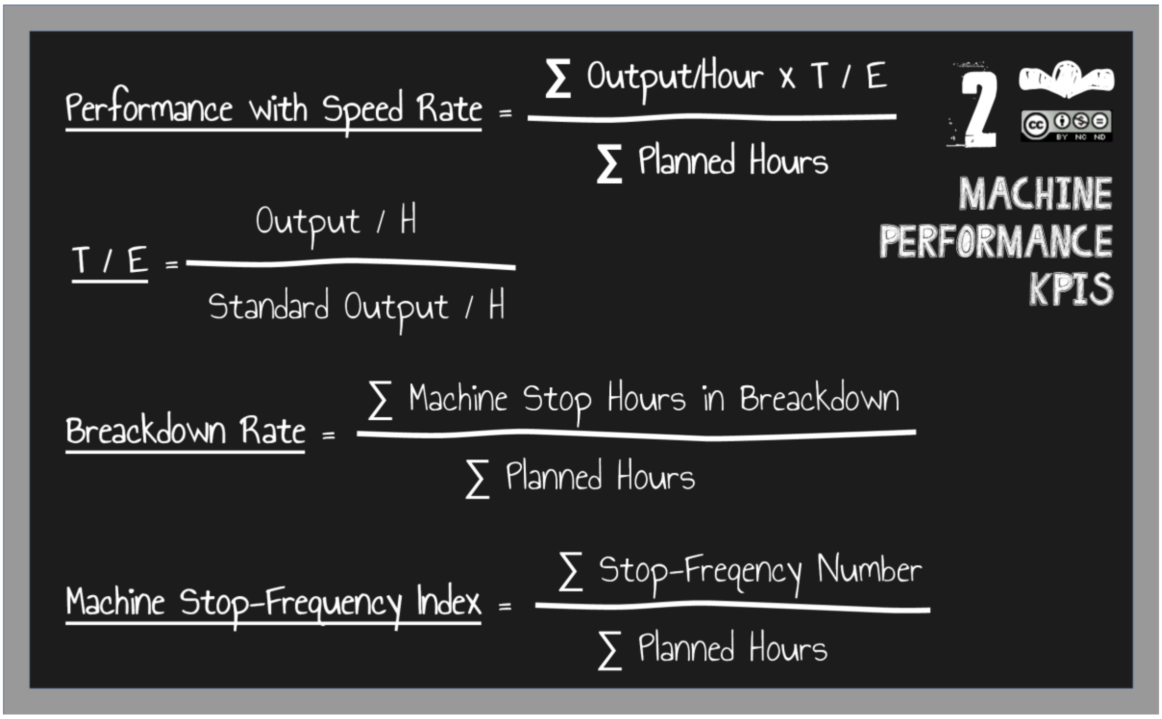
$$\text{Machine Performance Rate} = \frac{\sum \text{Operative Hours}}{20 \text{ days} \times 8 \text{ hours} \times 2 \text{ shifts}}$$

$$\text{Machine Working Rate} = \frac{\sum \text{Operative Hours}}{\sum \text{Planned Hours}}$$

Operative Hours are the Actual Machine Working Hours

20 days x 8 hours x 2 shifts is the meaning of wished hours against the [investment.

Planned Hours = ∑ Operative Hours – (planned stop + morning meeting + 5S activity and others). The meaning of "Planned machine working hours".



2

MACHINE PERFORMANCE KPIS

$$\text{Performance with Speed Rate} = \frac{\sum \text{Output/Hour} \times T / E}{\sum \text{Planned Hours}}$$

$$T / E = \frac{\text{Output / H}}{\text{Standard Output / H}}$$

$$\text{Breackdown Rate} = \frac{\sum \text{Machine Stop Hours in Breackdown}}{\sum \text{Planned Hours}}$$

$$\text{Machine Stop-Frequency Index} = \frac{\sum \text{Stop-Freqency Number}}{\sum \text{Planned Hours}}$$

— These KPIs show how to realize machinery high performance.

—By means of **TPS,** it is possible to say that we control from the point of view of things through **Pull, WIP, Inventory, etc.** And TPS also has machinery's KPIs, for instance, and in the use of Toyota words:

—**The Rate of Operation Availability**, which is the rate of actual working hours, in Kanban, regarding the planned working hours...

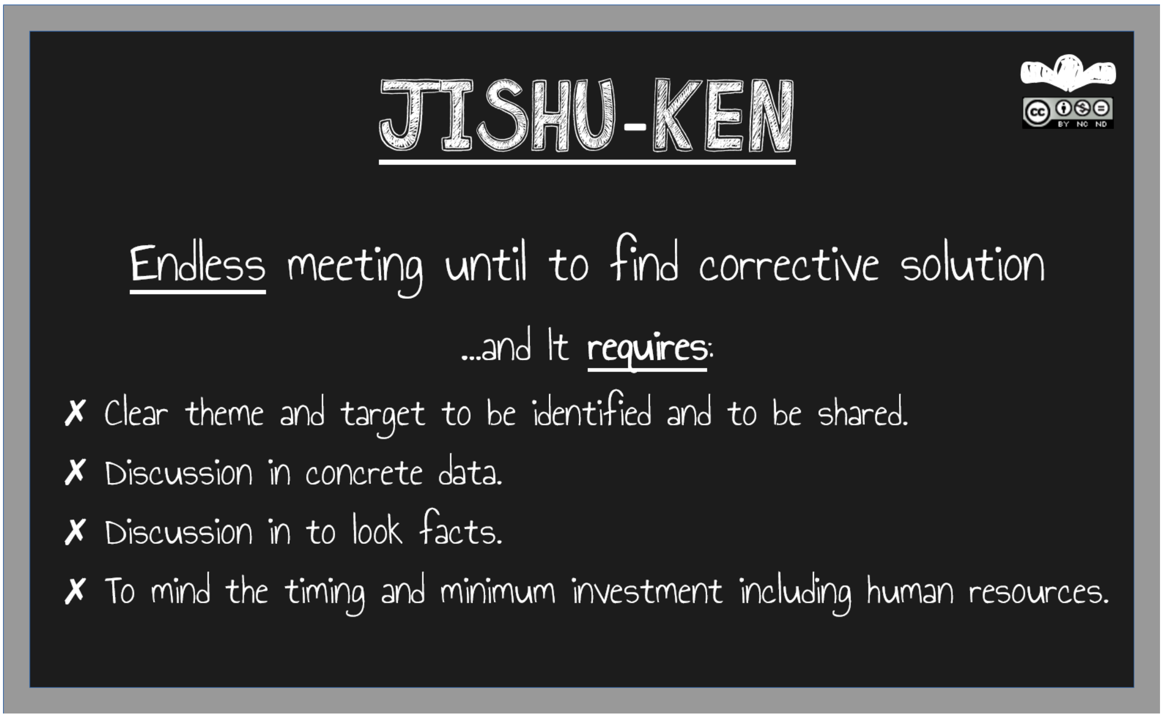
—**The Rate of Operation**, which is the rate of "Load (comes from demand: pull from the next)" regarding the full machinery capacity (in the scheduled time). Then this rate is decided with the situation of "Pull of the next process or customer demand". This rate also is used for the judgment of investment performance...

—And, are these Toyota-KPIs identical to the previous ones? **Yes, they are.** But there is a big difference —and I continued—. The working hours or Load come from Kanban pull or demand and next pull in the concept of JIT...

—Your production looks at from the point of view of the machinery. But you should look at the things in the thought of TPS. When looking your factory, it is quite clear that there is the problem of Overproduction. Why does it occur Overproduction? —I asked for.

—It is not necessary citing TOC (Theory of Constraints), but there is the problem of the total Line Balance which has the bottleneck processes. And additionally, you are seized with the thought which new investments (the machinery) must be used to their full capacity. Of course, this thought is wrong and you need to look at the production from the point of the "things" in JIT rather than to look at the point of view of "machinery"…

—Now as I have suggested, please start your Jishu-Ken which is endless meeting until to find a corrective solution and the theme is "**Making Stream of Production**". —and I wrote on the blackboard as next:



JISHU-KEN

Endless meeting until to find corrective solution

...and It requires:

✗ Clear theme and target to be identified and to be shared.

✗ Discussion in concrete data.

✗ Discussion in to look facts.

✗ To mind the timing and minimum investment including human resources.

— Please, start... — I omit the discussion. But I mention below the conclusion of the project in their Jishu-Ken session.

1. Complete the activity of 5S. They had already the base of 5Ss activity in regular Katazuke and Gemba team activity. They intended to improve from Katazuke level to true 5Ss.
2. Challenging Kanban introduction in running desperately. They knew it was a very complex obstacle. But his determination was very hard. One of the concerns was "QRKA (Quick Response Kaizen Activity)" just when a problem or difficulty may occur. This company decided to use Kanban as one of the Kaizen media.
3. The current project team was adopted to the Team "Kanban introduction with QRKA".

And so the way I spent my time visiting the factory.

Now again. **Why is Overproduction the worst Muda?...** And Overproduction is "**cause and effect**".

- **Cause:** It is happened in. The cause of the excess of people, the excess of machinery and/or the balance of the process line. Then as the results…
- **Effect:** Over-Processing (process too advanced material advanced use, inventory or WIP increase, Worsen Cash-flow, Increase of interest, Worsen Space efficiency, Containers & shelves increase, Increase of difficulties of process control, transportation & handling increase, an increase of lot defect, an increase of line stop, worsen safety and etc. These difficulties are also the cause of the worsening of the direct cost of the material, the direct and indirect cost of labor, the cost of depreciation and the general and administrative costs.

  These all become the causes of worsened direct material cost, direct labor cost, indirect labor cost, depreciation cost and general & administrative cost.

  Invisible bad influence: Invisible production flow, worsen Gemba mind (Sense of 5Ss, Cost mind, Kaizen mind, Quality mind, Safety mind).

Thus, the Gemba which has a stagnation and is not visible the manufacturing stream has some Muda and/or problems.

Overproduction is to produce products, parts or materials more than the “customer’s pull’, or 'Pull of the next process’ by ignoring the 'standard stock or standard inventory'.

Standard Stock or Standard Inventory: In fact, there is no such word in any Toyota book and I added this to explain my students. Why?

As I wrote, Kanban required having stock or inventory. These stock and inventory are one of Muda. But these are not "Over" Production but are controlled with Kanban. However, these are out of the definition of "To produce products or parts or materials more than customer's pull or pull of next process".

Therefore I added such word willingly.

Flying notes by Kimura-san

Is a Kanban-System so difficult to "adopt"?

No, It is not difficult. But the real difficulty is to establish the condition that allows the use of Kanban.

This company didn't have the essential condition enough. But he decided to use Kanban as a mean to improve the essential condition. They introduced Kanban in a line firstly. But they soon understood the insufficient preparation of the essential conditions.

A condition that must meet Kanban and of great difficulty, is to have the capacity of process stability (to avoid Lack of material, Muri & Mura of order, Machine trouble, Lack of worker, Low skill worker and Working environment.)

In fact, it was impossible to adopt Kanban in his factory. However, they decided to use Kanban to develop the management of their factory.

When a defect occurred (for example), the QRKA team sometimes helped re-process the parts in a special Kanban and constructed the countermeasures to avoid the reoccurrence of the defect.

Saying this is easy and also easy to write. But this team worked well and reduced the occasions in which it was necessary to issue a special Kanban (Rinji-Kanban: Extraordinary-Kanban).

It should be QRKA and shouldn't be SQC (Statistical Quality Control). But why not use SQC (Collection of data, Data analysis, Making countermeasures and Follow-up)?

If this action were to be carried out with SQC, this company couldn't obtain the essential condition even after 1000 years of trying.

This is why the tool is QRKA in a Quick action, as mentioned by the tool.

From my point of view, it was a reckless of this company to challenge Kanban, because his level in my Factory Management Checklist was less than 50%. Then I firstly recommended to provide certain level of basic factory management.

In fact, Kanban is used as one of a tool for improving the process. Moreover, with using Kanban for process improvement, it is possible to be called the Kanban system implemented. Improving the process reliability, improving the production control skill and then reducing the number of Kanban in the process to reduce stock and inventory. But this improvement activity must be attempted in a certain level of factory management which the diagnose result in my checklist more than 75%. And such reckless challenge is not recommendable.

Muda by Over-Processing.

The original meaning of Over-Processing is:

> *"Over-processing is the work itself does not need or does not add value to the products"*

When I was young, I was taught that don't give a job of making the person fool. A job of making him fool? What is the work? The work is that there is no ground him to feel satisfaction and his work doesn't give any value to the products.

One day, while I perform my looking around of the factory, my eye fell on the job which was made by a new comer. His job was to make a mark in parts to identify the position of crimping.

Then, I called the Line-Leader and questioned 2 points.

—Did you teach him the meaning of this work? —I asked firstly.

—And can he feel satisfaction to this work? Because this work cannot give any value to the product —I made as a second question without actually expecting response—. Then I required him to improve (eliminate marking job) this situation until me to come back after looking around the factory.

Actually, the marking can help the job of next process which is crimping in the position. But this work does not give any value to the product.

When I came back to this process, the line leader, the crimping operator and the new comer had already developed the temporal new crimping tool which can identify the crimping position.

Another example...

When I was looking around my factory, I found strange process In the middle of the assembly line, there is a process of tightening the screws. And in the inspection process, again one person re-tighten up same screws with the torque wrench.

As you understand, this process of re-tightening up using the torque wrench does not give any value to the products.

—But, why are you doing this job? —I asked the leader in the Gemba.

— there was a customer's concern about the looseness of the screws torque —he said—. And since this customer's concern, this process in inspection was added and continued as the temporal countermeasure.

Of course, this re-tighten process was eliminated with the improvement idea of screw tightening process with the hung driver which has the function of torque control.

Again one of the enemy of Kaizen is the accustomed to a work.

In fact, there are many cases of Over Processing in a factory. And it is one of difficult matter to Kaizen, because of (I call) human inertia which human wishes to continue a familiarized method or cannot find the irrationality.

Muda by Over-Quality.

Over-Quality is also a kind of Over-processing.

One day I visited a company which produces the parts of home appliances. When I came across the process of polishing, I saw the scene of some operators doing mirror finish. After the plant tour, I questioned to the director:

—Do you make the mirror-finishing for all the parts?

— No, not all. But it is required in the specification to make mirror finish in the place to be visible by the consumer.

—And are all the producing parts used in the visible places? —I asked for.

—I do not know. But we obey the specification.

—You told me that you recently are required the price down by the customer, aren't you? —I also asked—. If so, it is not a bad idea to suggest to the customer to eliminate the mirror finish in some parts which the place not to be visible, do you?

Subsequently, this company and the customer made the investigation in the 'Genbutsu[15]' home appliance one by one of the parts. Then it was succeeded many of the parts to eliminate the mirror finish process and the cost reduction.

There are many cases of the cause of Over Processing in a specification caused by doubt a customer's specification.

As I have written, my previous company manufactures wiring harnesses for the vehicle. And when the new car model is planned by car manufacturers, we do the activity of "Value Analysis (VA) and Value Engineering (VE)".[16]

This activity is a matter of death or life for us. Because the price of the wiring harness is decided in a wide negotiation on the Planned Cost. The suggestion of good ideas is directly related to our profit.

Then, after getting the drawings and circuit information which are the detailed specification, my group initiates the **Simple Quality Function Deployment (SQFD)** activity,

The SQDF Method:

Preparation of material: Drawings, Circuit specifications, Sample harnesses, Automatic machine, Performance table, Material catalog and specifications, Working standard, and large white papers, to write down ideas.

Team Building: Quality Engineer, Production Engineer, Design Engineer, Procurement, Accounting, Sales, Production Line Leader and Guest Engineer[17].

And started a discussion...

---

[15] **3G (Genba, Genbutsu, Genjitsu)**: The Real Place, The Real Elements and Materials, The Real Data & Understanding

[16] **VA/VE:** Value Analysis/Value Engineering evaluates your products and supply chain from a unique perspective allowing for cost reduction, improved quality, and meaningful supplier relationships. It helps people creatively generate alternatives to secure essential functions at the greatest worth as opposed to costs. This is referred to as value. https://en.wikipedia.org/wiki/Value_engineering Steps: (1) Gather information, (2) Measure, (3) Analyze, (4) Generate, (5) Evaluate, (6) Develop and expand the ideas, (7) Present the ideas.

[17] **Guest Engineer:** Customer Support, visiting the customer line for the design activity.

My method for the development of Simple Quality Function Deployment (SQFD)

1. Cutting the drawing from top to bottom and blanches to trunks in very detail parts and individual circuit.
2. Putting the individual drawn parts in the large paper and discussing and recording ideas in the large paper….
3. Discussing and recording ideas on the large paper.
4. And all parts, all components, and all circuits are examined.

Simple Quality Function Deployment (SQFD) is not equal to Quality Function Deployment (QFD), but it is a simpler and simpler modification of the method due to the amount of workload. I will describe the QFD in the TQM column.

The example of one part examined:

—Why is a convolute tube required in this part? —asks the president of the SQDF meeting and keeps asking as next...

—What is the required function of this convolute tube?

—What is the condition when installing?

—What is the circumstance of this part in the use by the consumer?

—And how much is this?

— According to the engineer of the customer, there is a concern of damaging wiring harness when installing the harness through clearance and concern of spattering edge of welding. —says the Design Engineer.

Therefore it was added in the drawing.

— Guest Engineer. Did you confirm this? —then, asks the President.

—Yes, of course, I confirmed —said the Guest Engineer—. Yes, of course, I confirmed. There is no welding spatter edge which the customer design engineer concerned, but there is the concern of small sharp edge inside the clearance, —and continued—, particularly my concern is damaging wiring harness at not only the installing but also the vibration of the car body in the use by the consumer.

— So, it is necessary to consider some protection for installing wiring harness and also protecting from the car body vibration... —Then the President Asked— is this convoluted tube necessary? It is necessary some protection. But is it not necessary to be convoluted which is very expensive? Is it possible to exchange to cheaper protection material? Let's consider the alternative idea.—suggested the President.

> **The necessary function:** Protection from the risk of installing harness. And, protection from the damaging harness in the vibration with a small edge.
>
> **Condition:** Temperature, Vibration, Oil resistance (in temperature), Hardness, Durability.

Then an alternative idea which is cheaper vinyl tube was suggested.

—Why is this part of wire length tolerance so severe? If this condition, very special assembly process is required. In what condition this part is installed in the car? Guest engineer. Did you confirm the condition? —the Gemba Leader asked.

— Yes, I did and also negotiated to the customer design engineer. But he insists this tolerance, because of the concern of biting harness —replied the Guest Engineer—.

—Guest engineer, please once again confirm the necessity in **Gemba, Genbutsu, and Genjitsu. (3G)** —questioned the President.

And after the investigation, this severe tolerance was corrected.

Let's check the necessary function of circuits one by one based on the circuit specification (circuit diagram).

> **The considerable condition:** Ampere and size, flexibility, cold & heat, oil, vibration. Cables for wiring harnesses have more than 50 different types without the size and color in the variation of (coating) insulating material. Then the circuits also are required to consider the chose suitable cable in the required function.

Above is one part of cost reduction suggestion and the Over Processing is targeted. But the customer's engineers don't like such proposals and said.

—Thanks for many suggestions for lowering quality level. This convoluted tube also was written for sharp edge concern —Customer said.

—According to the investigation of our guest engineer, there is no such sharp edge concern —our team answers.

—There is the concern of happening sharp edge —answers the customer.

—Our concern is not the large sharp edge, but the damaging wiring harness with the vibration with a small edge. For this concern, it is sufficient with cheaper vinyl tube.—we answer and, we could have continued as next —, additionally this is your quality control matter, and not us. If you insist to put the convoluted tube in over quality, please do with your cost.—and... So we would have answered ourselves…

Unfortunately, when I was the engineering manager, I did such activity. But I couldn't speak above 'gray' part to the customer, but I wished.

A mutter: Of course we do good suggestions in the activity of Value Analysis in deep design review. However, these suggestions are not welcomed by the customer design engineering section. Because they might feel having criticisms about their design. Particularly the suggestion of over quality elimination is unpopular. And they said that the suggestions always rink to quality degradation.

And we objected their criticism and told Quality things also are cost. Our suggestions are the reduction of unnecessary cost to the required function. We made such consideration on all wiring harnesses and all parts and circuits in individual wiring harness in the new development stage of the car.

And one of target is to eliminate the causes of Over Processing when starting the production,

> *"The Muda of Over processing is the work itself doesn't need or doesn't give the value to the products. Over-Quality also is included".*

And this Muda lurks in the process, also in the customer's specification.

Again the aim of TPM is to reduce and eliminate Mudas (Losses, Wastes) from the point of view of machinery preventive maintenance. However, all of 7 Mudas cannot be resolved with just TPM. And just Overproduction and Defect can be targeted. For resolving other 5 Mudas, other tactics must be required.

Next, a little more let's look at the issue of Muda in the 16 Mudas in Total "Productive" Maintenance.

Next, a bit more we see the Muda theme in the 16 wastes in Total "Productive" Maintenance.

2) The 16 Muda in TPM

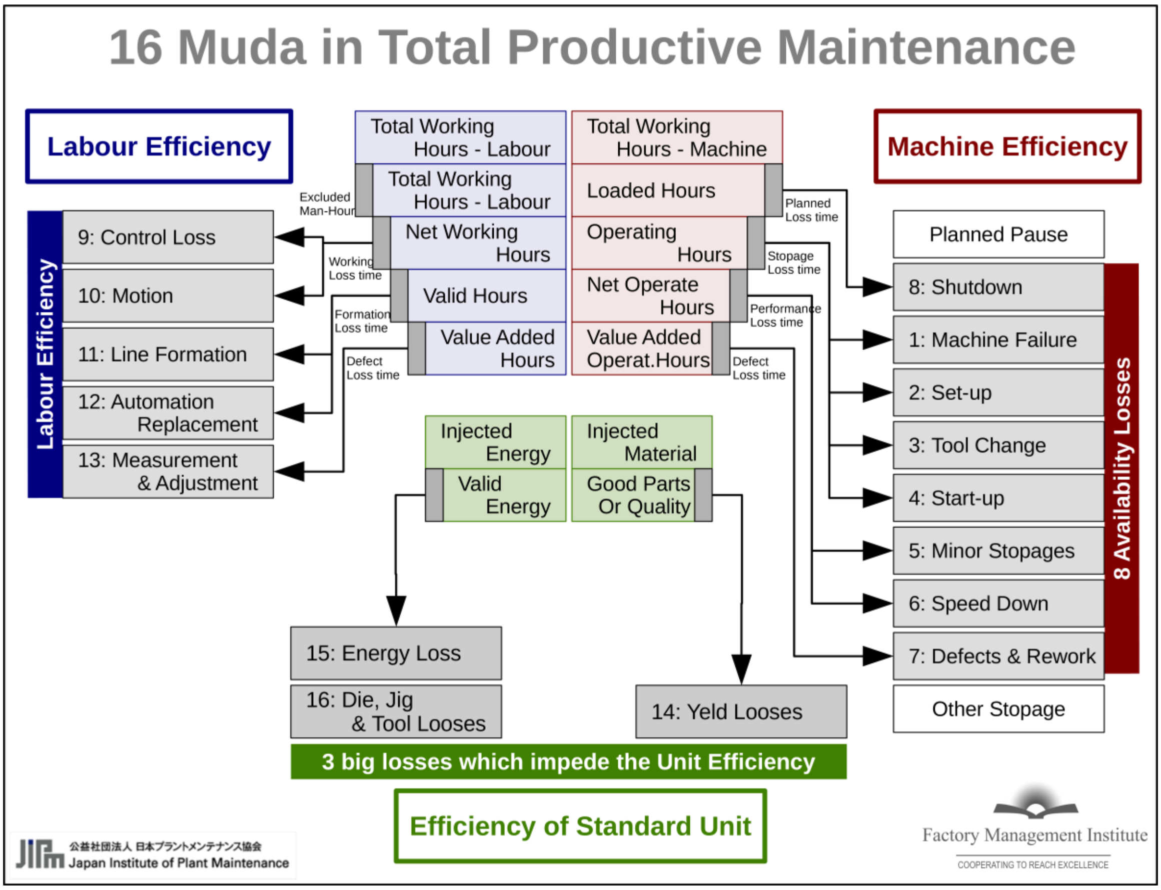
When I explain Muda, I use the 7 Mudas of TPS and sometimes this chart also as the wisdom of our pioneers. However, when using this chart, I need to make some annotations.

In the above image, we can see on the right, the box with "**Planned Pause**", where the JIPM mentions that it does not represent a problem. Nevertheless, in the example of the previous argument of the company, about the ‘hot and cold argument’, one criticism was generated based on which some old machines were stopped and replaced by new machines under the name of "**Scrap and Build**". In fact, the accuracy and output of the old machines were reduced. Then the introduction of new machines was planned. And the old machines were put in the warehouse as "**Planned Pause**".

But an opposing view was raised by the Accounting Department: "It is stupid to abandon such machines that have finally ended their depreciation." And, the opinion of Accounting is correct.

I have written, in previous readings, that Toyota is a stingy company and in its plants, there are many old machines, but they are well maintained.

In a dialogue, my Toyota friend told me that in Toyota a machine does not get old because old or



problem parts can be renewed. Of course, the type gets old. But most important thing is that a machine can follow the necessary Takt-Time. And if one machine cannot go in the speed, it is acceptable to use two slow machines.

Anyway, the section of "Planned Pause" its situation in the chart is acceptable. The problem arises when Muda No. 8 is considered: “Shutdown Loss”.

8: Shutdown Loss

According to JIPM's explanation, "shutdown" is a "**planned pause**".

The shutdown is for regular or temporary, maintenance and, it is for periodic review, regular maintenance such as clean-up, inspection, parts change, statutory inspection and accuracy checking.

Now, is it possible to classify this one as Loss or Muda?

Anyway, I don't want to categorize it to be Muda because of next reason: The one is the Shutdown, if could be categorized as Muda, may not correct and causes serious misunderstandings. **In order to show it, I write a true story in my previous company:**

> *Many years ago, in the monthly production meeting, there was a conversation and discussion. At that time, there was a serious shortage of capacity over demand, in the process of preparing parts with the hundreds of automatic machines.*
>
> *In fact, the process corresponding to the automatic machines was one of the main bottlenecks. However, there were 2 ~ 3 machines that had to be stopped in their process for a day. While the cause of the shutdowns were not the problems of the machine, but the inspection of regular maintenance.*
>
> *My company had, and has, the standard of regular maintenance inspection each 6 months of production and a complete overhaul and rebuild each 8 years of production.*
>
> *The Production Control Department complained about such a situation and required a temporary halt to regular maintenance. And he said;*
>
> *—The machines stoppages are Muda and disturb the production.*
>
> *—What’s Muda and is! —answered the person in charge of maintenance—. We work on the standard.*

— I never say that your work is Muda, but you stop the machines which are not necessary to stop because of no machine trouble. This is Muda, isn't it?

—Preventive Maintenance is inspecting and maintaining the machine before it has any kind of trouble —the Maintenance Manager replied.

—I know and I never deny the importance and your activity. But I require just postpone the timing. Now the production situation is very serious. Now it is in peak production volume because of new model introduction which the current and new model is running in parallel. In the first place, why does it take one day for one machine for the inspection? Isn't it possible to shorten half day, is it? Also, the standard which to be each 4 months is rational? Isn't it possible to rationalize the maintenance activity?

—Now we are also doing the improvement activity of regular inspection & maintenance to reduce machine stopping time. The key activities are the 5Ss (Seiso) activity and regular oiling by the operator. And so far the standard is Each 6 months.—answered the Maintenance Manager and continued…

—One day stoppage to half day is not possible. To reduce half day, it is necessary to reduce checking points or to increase the maintenance staff. But both of them are not acceptable. There is no ground to the standard of each 6 months. And we need to gather the data of 6 months results in the parts and points maintained. But so far we have no rational data to accept your requirement —finally said the Maintenance Manager.

—In order to face this shortage of capacity, we decided to adopt the idea of extending to 3 temporary shifts during these 4 months —agreed the President of the meeting who was the Factory Manager too—. And now on the discussion of the maintenance activity of the Machine, I need to clear in 3 points;

1. *Of course, the maintenance uptime is never Muda, even though the cause and effect relationship cannot be identified in figures.*
2. *In order to identify the cause and effect relationship in maintenance time, machine usage time, the contents of maintenance activity, operator's skill, breakdown and change parts, and the statistical data gathering must be continued.*
3. *Though the maintenance time is not Muda, but it is required the "cost". And a cost is one of investment. Investment must be follow the efficiency.*

This story was just as I told it.

As I wrote, when considering a Muda, it is necessary to see from the point of view of production and management. So, **the aim of Shutdown is to provide a good managerial condition.**

Then I tell finally that Maintenance and Shutdown time is not Muda and shouldn't be categorized in Muda (Waste, Loss). However, both of time are the objects of improvement.

Another annotation of difficult comprehension is the number "**12: Automation Replacement**".

12: Automation Replacement

The article "**12. Automation Replacement**" is into the category of Losses that Impedes Labor Efficiency. And, according to the description of JIPM refers to “The labor losses because of no replacement to the automation, though it is possible to replace and manpower saving”.

This article should not be classified as Loss (Waste, Muda) but it is an issue that most affects the efficiency of investment and engineering capacity.

There are three fundamental reasons and the first reason refers to the cost and effect of automation:

- It is a rather natural and common case that when production from a high-cost country of labor (eg Japan and the United States) is transferred to countries of cheap labor (eg, Southeast Asia) that, also, they are not countries of high engineering capacity, the automatic production process is broken down to be a semi-automatic or manual process, due to the issue of "Cost (Investment) and Effect".

  This point does not address the question of whether it is Muda or not, but the question of the efficiency of investment. At this point, I see a misunderstanding.

The second reason is the issue of technical capacity:

- No matter what the hope of obtaining a differential for using automation, if there is no technical capacity for the maintenance of machinery: About the supply of spare parts; About the use of machinery and a quality infrastructure; About the electricity supply. No, it is not possible to replace the workforce with automatisms.

  I tell you one little story about this technical capacity, but it is not the story of Industrial Automation, but a story about some government mistakes.

  When the crisis occurred in Iraq, Japan sent some aid. Among the aid was the case of the simple power plant and the case of medical equipment for hospitals. And unfortunately, both were failed because this country did not have the technical capacity to use them. After a year, the Japanese government found that this equipment either were not exploited or were malfunctioning. The machines were left under dust covers

And the third reason could explain it with an example referring to Toyota and refers to Kaizen:

- When a new process of work arises, Toyota, in the first place tries to do it completely manual way, although it can be done using an automatic machine. And then it replaces for better tools in **Kaizen**.

  The improvement work in Kaizen replaces one part to a semi-automatic or automatic process and then replaces the process by a combined man-machine process. But, in all of cases, **Toyota attempts to start from the manual to find new Kaizen ideas**.

Anyway, what is the definition of Muda (Loss, Waste)?

My definition of Muda is, again:

Muda is everything which doesn't create value, doesn't accompany value and doesn't provide value".

---

3) The 8 Wastes in "Lean"

The so-called "Lean" also defines waste. And it mentions 8 wastes.

At first, I tell my opinion. I don't like and don't include this for teaching Muda. Why 8?

I read the lean book written by Pro. J.P Womack (Lean Thinking). And I think the original of "8" is this book.

J.P Womack introduced the word of Muda in his book and said

> *"Muda. This is one of the Japanese which the reader should know. Muda in Japanese means the activities that, when executed, they consume resources but do not produce any value".*

And he listed up 8 kinds of Muda. Up to 7 Muda, the wordings are different but same to 7 Mudas of Toyota. And 7th is:

> *"7th is the products which don't match to the customer's demand".*
>
> *"8th is the service which doesn't match to the customer's demand".*

From Lean Thinking written by J. P. Womack. Translation by K. Inagaki

Yes. He added an 8th to the Toyota-7-Mudas. As you understand 7th and 8th are same. But after J.P Womack, the lean people insisted to the number of '8' to put the specialty (I think). If my guess is correct, it is stupid.

'The lean-people' consider reformulating the eighth Muda with the following content:

> *"8th is not using the ingenuity or the ideas of the employees. Caused by not listening to employees' suggestions, losing work time, ideas, skills, opportunities for improvement and learning".*

"The Toyota Way" written by J.K. Liker and the translation of K. Inagaki.

Consistency first and foremost…

Muda in Japanese means the activities that, when executed, they consume resources but do not produce any value.

Both J.P. Womack as J.K. Liker define Muda as shown below:

> *"Muda in Japanese refers to activities that, when executed, consume resources, but produce no value".*

Now you can understand that the 8th (Waste of Ideas) does not match the definition.

By the way, I would like to tell a short and funny story in this regard:

> I quoted from the book "The Toyota Way" of J.K. Liker.
>
> He wrote and explained Toyota 7 Mudas. However, Saying 7 Mudas in the title, but wrote 8 Mudas (with no explanation). Probably it is a careless and small mistake in the book. And probably it is the mistake of translation (Or Mistake of J. K. Liker?)
>
> 1st to 7th Mudas are referred in the book after the list-up. However, the reference of 8th is nothing. Anyway, it is a really annoying careless mistake.

Now let's look at other lean people voice in Social Network Services.

When searching the Internet, there are several ideas. And one of the examples is the following: TIMWOODS.

1. **T – Transport -** Moving of people, products, and information;
2. **I – Inventory -** Storage of parts, parts, documentation in advance;
3. **M – Movement** - Bend, rotate, reach, lift;
4. **W – Waiting** - For parts, information, instructions, equipment;
5. **O - Over-Production** - Doing more than what is required IMMEDIATELY;
6. **O – Over-Processing** - Stricter tolerances or better quality materials than necessary;
7. **D – Defects** - Re-work, scrap, incorrect documentation;
8. **S – Skills** - Underutilized capabilities, delegating tasks with inadequate training.

The TPS reference is 7, but 8 are quoted. And the problem is the Eighth "Skill" or "Non-Utilized People or Knowledge", according to some comments on Social Networks Services (SNS).

People's skill, abilities, and knowledge are not effectively or appropriately used. This happens frequently in large organizations where the skills and backgrounds of everyone are not common knowledge. The biggest crime in this category is not empowering or enabling the people most intimate with a process to improve the process.

It is quite true that human resources are one of the important managerial resources. Therefore it is understandable to be categorized in Muda. However, there is no end. When asking, "What is Muda?" to some people: "The biggest Muda in my company is to lose the opportunity of business". Or "The biggest Muda in my company is not to reflect our know-how to sales". And, another Japanese company said that "The biggest Muda in my company is not to use factory space effectively" because, in Japan, the terrain is very expensive. Etc.

Again, human resources are one of the most important management resources. So it is understandable to underuse the capacity of people and categorized it as Muda, however, machinery and know-how are also important management resources. And there is no end.

Also here is a lack consistency and it does not match the basic concept of Muda.

For instance, if using high ability worker in a line work which doesn't require so high knowledge and is a very simplified process, is it Muda and not to add any value to the products? It cannot be said so.

Considering "underutilized capabilities" from the perspective of replacing human resources with machinery, because both of them are management resources. So, if you can consider Muda in the case of the replacement of machinery, a machine that has, for instance, 100 units of speed and if only 50 units are used, could it be one case of waste? No, it is not possible to define it as Muda. And depending on the situation, it is Muda and it is not.

If the machinery has his full capacity demand and if running in 50, it is Muda. But, if the pull demand is under the full capacity, not running in full capacity is not Muda. The Opposite!

In such case, running in full capacity is Muda. A machinery should show the ability in the pull from the next process or pull of customer's demand and keep the pull speed. And dependingg upon the pull speed (Takt-Time), the machinery should run at the required speed. And this required speed isn't always 100. The correct judgment is not the machine capacity, but the speed of pull.

Returning to the 8th Muda about not using employee ingenuity or Underutilizing capabilities. Such theme should be taught in the Utilization of Management Resources and should not be taught in the Mudas of production.

Thus, in Management Resources, there are Human Resources, Material Resources, Financial Strength, Information, Trademark, Credit, Know-how and Patents, Management Method and Corporate Culture.

Toyota's 7 Muda have been considered by the pioneer. And it should not be acceptable to add such an idea carelessly, and with such a lack of consistency.

The concept of Muda (Waste or Loss) is a very important concept in Factory Management and TPS. For example, the book "**The Toyota Way**", when looked at in the index, the word Muda is used in 47 places and there are more than 33 times the word JIT is used, throughout the book. This word is very important.

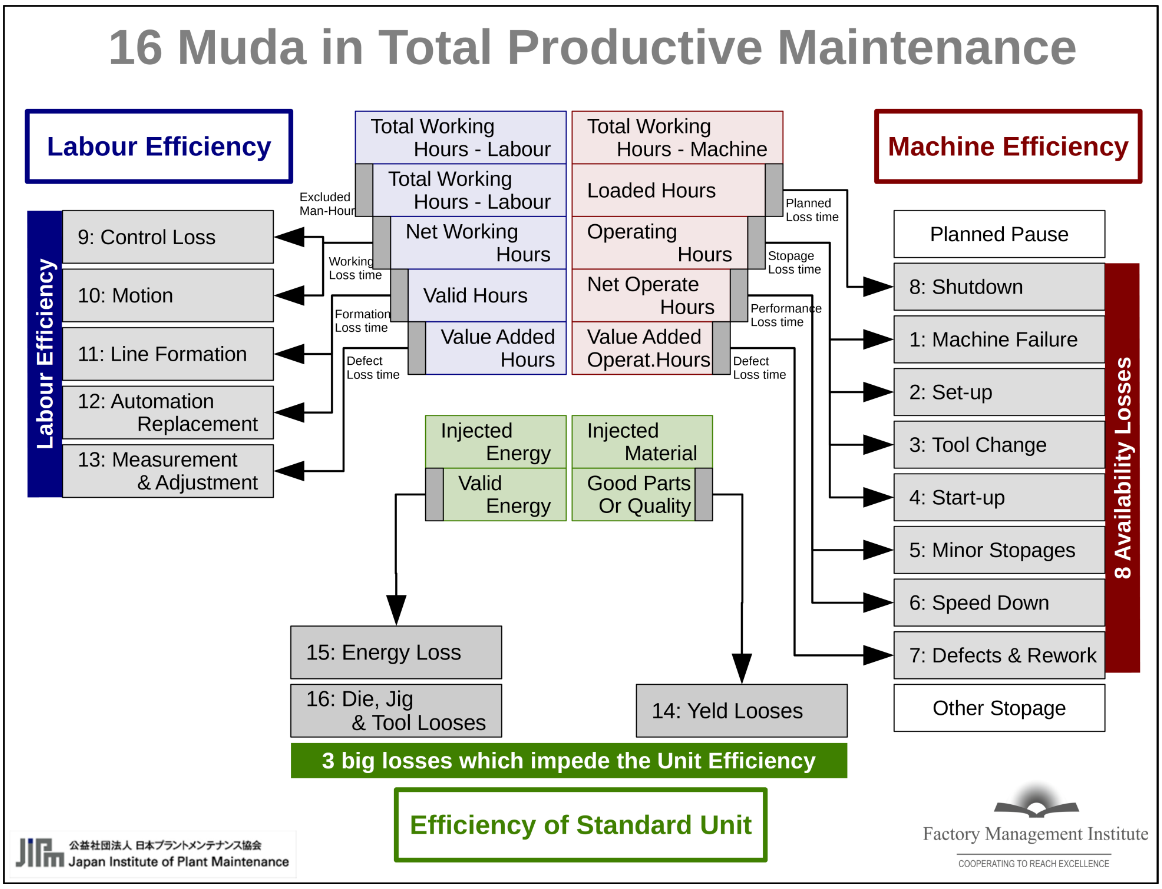
By the way, the word "Lean" is used in 117 places, which are more than 75 appearances of the word Toyota (Toyota Production System, Toyota Brand name, Toyota Technical Center, etc.).

Anyway, this writer likes the word "Lean". However, the title of the book is "**The Toyota Way**". Then you should keep the Toyota shape or at least the important and basic concept should be maintained. Thus, TPS is one of the "**Lean**" methods. But, and just because, Lean is not equal to TPS.

4) MUDAs of the Total Preventive Maintenance (TPM)

Please understand that the aim of TPM not to pursue the false improvement of the performance of the machinery, but to pursue the production capacity of the things necessary to produce, in the timing to be necessary to produce and in the quantity to be necessary to produce. And to achieve this goal, the machinery is maintained at full capacity.

As you can see, this JIPM chart has 3 parts. The RIGHT side, with the RED frame, is part of the Machinery. The LEFT side, in BLUE, is the Work part. And the GREEN background is the part of Material, Energy, and Tool.



And in **TPM,** I describe the methods to eliminate the 7 Muda of the Machinery, those are:

1. **Machine failure**
2. **Set-up / Preparation**
3. **Tool / Utility Change**
4. **Start-up**
5. **Minor stoppages / Small pauses**
6. **Speed Decreasing**
7. **Defects and Re-work**

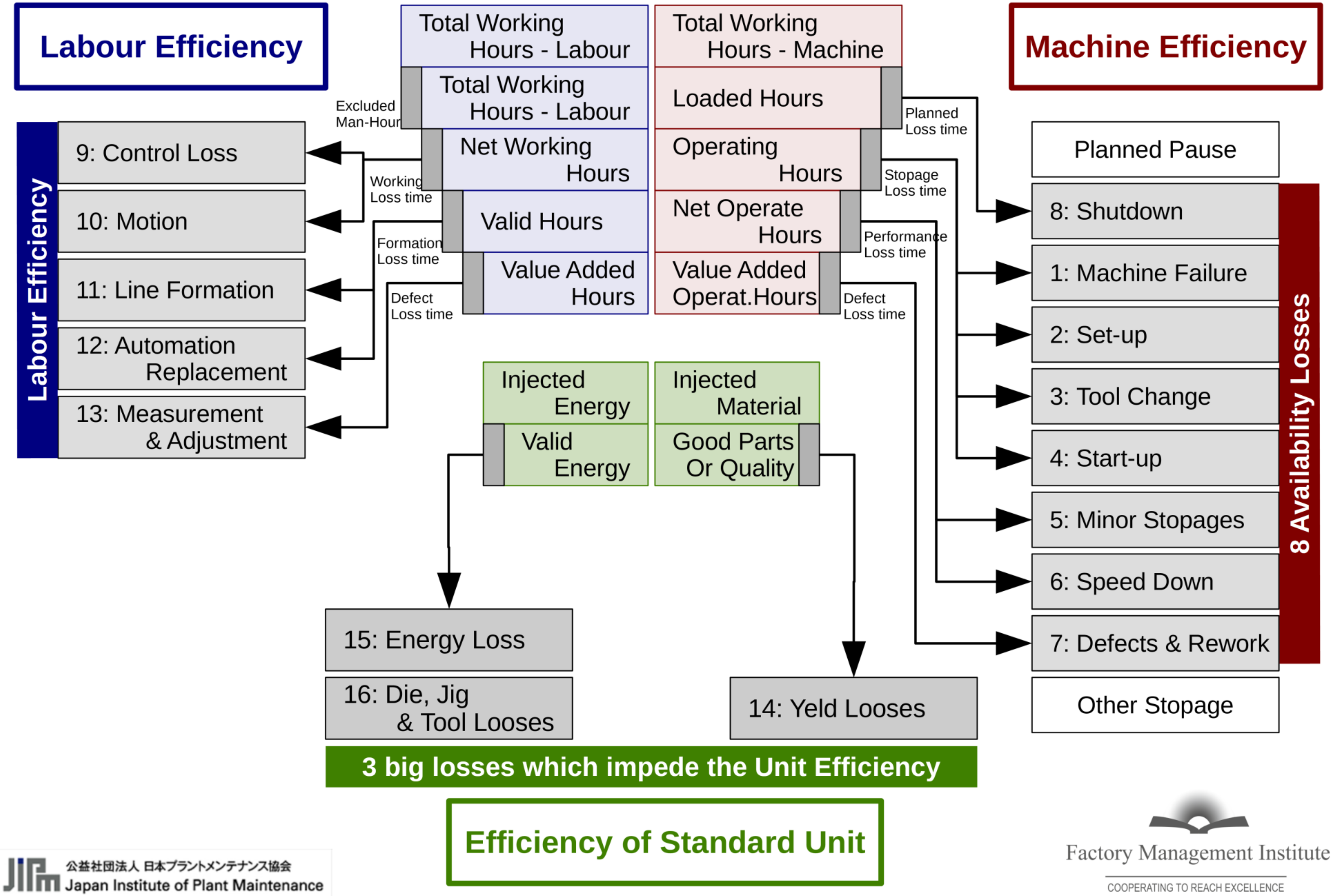
And Tool of machinery & Sare-Parts

VII. Guide for the next lectures about TPM

Approximately I will describe above themes in my experience. And case by case I add additional themes.

1. **PM by maintenance section.**
2. **All People's Participation to machinery maintenance.**
3. **Oiling to be one of key activity for autonomous maintenance.**
4. **Skill training and the evaluation method.**
5. **5Ss (Seiso and Seiketsu) and maintenance.**
6. **Seiso & Seiketsu and scattering protection.**
7. **The use of visual control.**
8. **KPI and control.**
9. **Autonomous maintenance by the operator.**
10. **Initial Products Quality Control activity.**
11. **IoT and machinery control.**
12. **Gemba Safety Committee.**
13. **Total Preventive Safety (TPS).**

16 Muda in Total Productive Maintenance



Labour Efficiency

Total Working Hours - Labour

Excluded Man-Hour

Total Working Hours - Labour

Working Loss time

Net Working Hours

Formation Loss time

Valid Hours

Defect Loss time

Value Added Hours

Labour Efficiency

- 9: Control Loss
- 10: Motion
- 11: Line Formation
- 12: Automation Replacement
- 13: Measurement & Adjustment

Machine Efficiency

Total Working Hours - Machine

Loaded Hours

Planned Loss time

Operating Hours

Stopage Loss time

Net Operate Hours

Performance Loss time

Value Added Operat.Hours

Defect Loss time

Planned Pause

8 Availability Losses

- 8: Shutdown
- 1: Machine Failure
- 2: Set-up
- 3: Tool Change
- 4: Start-up
- 5: Minor Stopages
- 6: Speed Down
- 7: Defects & Rework

Other Stopage

Injected Energy

Valid Energy

Injected Material

Good Parts Or Quality

- 15: Energy Loss
- 16: Die, Jig & Tool Looses
- 14: Yeld Looses

3 big losses which impede the Unit Efficiency

Efficiency of Standard Unit

公益社団法人 日本プラントメンテナンス協会
Japan Institute of Plant Maintenance

Factory Management Institute
COOPERATING TO REACH EXCELLENCE